



2008 TechCon

PRELIMINARY PROGRAM

APRIL 19-24, 2008 | HYATT REGENCY CHICAGO ON THE RIVER WALK, CHICAGO, IL



Technical Program

April 21-24, 2008 | *Featuring a New Symposium on Cleantech Energy Conversion and Storage*

Plus! Hot Topic Sessions on:

- Biomedical and Pharmaceutical Applications of Vacuum Processes and Coatings
- High Power Impulse Magnetron Sputtering (HIPIMS)

SESSION DETAILS START ON PAGE 5 >>>



Education Program

April 19-24, 2008 | *New courses on Hot Topics offered in 2008!*

Anyone can take advantage of the practical problem-solving courses developed by SVC and taught by some of the most respected professionals in the vacuum coating industry.

This year we've added three new courses on Hot Topics.

DETAILS START ON PAGE 18 >>>



Exhibit + Innovators Showcase

and Live Demonstrations April 21-22, 2008

New in the Exhibit Hall in Chicago:

- Free Wireless Internet throughout the Exhibit Hall!
- Innovators Showcase Presentations
- Live Product Demonstrations

- 1 **Renew Your Membership**
- 2 **Register for the Conference**
- 3 **Reserve Your Hotel Room at the Hyatt**

Do it all on-line at www.svc.org

SEE PAGE 13 >>>

Message and Invitation

from the
Program Chairs

The 2008 program of the 51st SVC 2008 Technical Conference offers a large selection of opportunities to appreciate the advances in the fields of vacuum science and technology and vacuum coating based technologies and related areas. By reading through this Preliminary Program, you will clearly see why you should start to make your plans now for traveling to Chicago.



Photo courtesy of www.meetinchicago.com

Chicago 2008

The program will address a number of technological breakthroughs and point to the most important, promising, and attractive developments for the future.

The 51st SVC TechCon will convene at the **Hyatt Regency Chicago Hotel on the River Walk, Chicago, IL, on April 20–24, 2008**. As an important theme of contemporary research and technology, the program focuses, among other topics, on environmental issues, power conversion and generation, and smart and functional materials by featuring the **Symposium on Clean Technology Energy Conversion and Storage**. The flavor of the Conference will already be set on Sunday evening by the **Plenary Session** with a presentation by Lawrence L. Kazmerski, National Center for Photovoltaics, National Renewable Energy Laboratory, entitled “Solar Photovoltaics Technology: The Beginning of the Revolution,” and on Monday morning by the **Keynote Lecture** of Subhendu Gupta, of United Solar Ovonic, entitled “Manufacturing of Thin Film Silicon Solar Cells.” You will have the opportunity to gain the perspective of technology leaders to tone the timing and direction of this important and high impact field. This overview by leading researchers is clearly something to look forward to.

The above Symposium and lectures will be complemented by two other special events, namely the **Hot Topic Sessions on Biomedical and Pharmaceutical Applications of Vacuum Processes and Coatings**, and **High Power Impulse Magnetron Sputtering (HIPIMS)**. These special program items accompany the traditional technical sessions that include Optical Coating, Large Area Coating, Plasma Processing, Vacuum Web

Coating, Tribological & Decorative Coating, Emerging Technologies, Process Modeling and Control, and the **HEURÉKA! Post-Deadline Recent Developments** session. The **Innovators Showcase** and live product demonstrations will be featured in the Exhibit Hall.

In particular, advances in specific areas of general interest to the audience will be described within the traditional **Donald M. Mattox Tutorial series**. On Monday, the 2008 TechCon will host a lecture by Joachim Heberlein, University of Minnesota, who will present a talk on the “Principles and Perspectives of Thermal Atmospheric Plasma for Coating.” A second tutorial presentation on Wednesday will be given by Claes Granqvist, University of Uppsala, Sweden, who will describe the challenges and perspectives of smart thin film structures considered in environmentally and energy-related solutions, in his talk on “Chromogenics: From Motorcycle Helmets to Energy Efficient Buildings.”

A Full Schedule

The various Technical Advisory Committees together with MPI and the Program Committee have worked hard to assemble this Preliminary Program, and we feel you will have as difficult a time scheduling your days as we have had fitting it all in. Thanks to a large number of contributors and equipment manufacturers, we have prepared a very full program of offerings ranging from our nearly sold out **Exhibit** to the comprehensive **2008 Education Program** offerings. The ever-popular basic courses on vacuum coating and vacuum technology are also being presented so that the program spans the six-day period of April 19–24, 2008. The TechCon activities will include the already traditional and highly successful topical

Networking Technology Forum Breakfasts and the popular “**Meet the Experts Corner**,” as well as the **5K Fun Run and Walk**.

This year we invite everyone to enjoy a night of live music and dining at the **Chicago House of Blues** networking event on Monday evening. Space is limited, so reserve your tickets when you register for the TechCon. See the Special Events box on the registration form on page 31 or on-line at www.svc.org.

As we go to press with this Preliminary Program, we should mention that there is still a chance for you to participate in one of the SVC presentation forums – **HEURÉKA! Post-Deadline Recent Developments**, the **Innovators Showcase**, and the **Poster Session** venues are meant to capture late breaking and key advances. Especially the increasingly strong Poster Session is organized within the most populated and actively visited area of the Exhibit Hall, where refreshment opportunities will be available. If you have contemplated these options for sharing your work, but have not made your decision yet, here is an opportunity. If you choose to participate, you will need to **submit an abstract via the SVC Web Site no later than March 1, 2008 in order to be included in the Final Program**.

Please check the SVC Web Site (www.svc.org) for further updates. We trust the program will encourage you to attend the 2008 SVC Technical Conference in Chicago, Illinois. We look forward to meeting you there in April 2008!

Ludvik Martinu, École Polytechnique, Canada (514/340-4099; lmartinu@polymtl.ca) is the Program Chair. Ladislav Bárδος, Uppsala University, Sweden (46/18-4713034; Ladislav.Bardos@angstrom.uu.se) and Ric Shimshock, MLD Technologies LLC (650/938-3705; ricshimshock4mld@aol.com), are the Assistant Program Chairs.

SVC TechCon Plenary Address

Solar Photovoltaics Technology: The Beginning of the Revolution

Presented by Lawrence L. Kazmerski



The prospects of current and coming solar-photovoltaic (PV) technologies are envisioned, arguing this solar-electricity source is at a *tipping point* in the complex worldwide energy outlook.

The co-requirements for policy and technology investments are strongly supported. The emphasis of this presentation is on R&D advances (cell, materials, and module options), with indications of the limitations and strengths of crystalline (Si and GaAs) and thin-film (a-Si:H, Si, Cu(In,Ga)(Se,S)₂, CdTe). The contributions and technological pathways for *now and near-term* technologies (silicon, III-Vs, and thin films) and status and forecasts for next-generation PV (organics, nanotechnologies, non-conventional junction approaches) are evaluated.

Recent advances in concentrators with efficiencies headed toward 50 percent, new directions for thin films, and materials/device technology

issues are discussed in terms of technology evolution and progress. Insights to technical and other investments needed to tip photovoltaics to its next level of contribution as a significant clean-energy partner in the world energy portfolio are provided. The need for R&D accelerating the now and imminent (*evolutionary*) technologies balanced with work in mid-term (*disruptive*) approaches is highlighted. Moreover, technology progress and ownership for next generation solar PV mandates a balanced investment in research on *longer-term* (the revolution needs *revolutionary* approaches to sustain itself) technologies (quantum dots, multi-multijunctions, intermediate-band concepts, nanotubes, bio-inspired, thermophotonics, . . .) having high-risk, but extremely high performance and cost returns for our next generations of energy consumers. This presentation provides insights (some irreverent, some entertaining) into how this technology has developed—and where we can expect to be by this mid-21st century.

Sunday Evening, April 20, after the Opening Ceremonies, Awards Presentations, and Annual Business Meeting at 7:00 p.m.

Lawrence L. Kazmerski is Director of the National Center for Photovoltaics at the National Renewable Energy Laboratory, Golden, CO. He received his Ph.D. in electrical engineering in 1970 from the University of Notre Dame. His research at Maine included NSF- and ERDA-funded work in thin-film photovoltaics and the report of the first thin-film copper-indium-diselenide (CIS) solar cell. He joined SERI (later NREL) as the first staff member in photovoltaics, hired specifically to establish efforts in the characterization of photovoltaic materials and devices. He led NREL efforts in measurements and characterization for more than 20 years. Dr. Kazmerski has published over 300 journal papers in the areas of solar cells, thin films, and semiconductor materials and devices. He has authored or edited four books. Kazmerski is Editor-in-Chief of the Elsevier journal, *Renewable and Sustainable Energy Reviews*. He has four R&D 100 Awards. Recently, he received the World PV Award from the international PV communities representing Europe, Asia-Pacific, and the U.S. for outstanding leadership and contributions to the worldwide advancement of photovoltaic science and technology. Recently, he received the 2007 Karl W. Böer Medalist for contributions to solar energy.



Monday Morning, April 21 at 8:30 a.m.

Keynote Presentation

Manufacturing of Thin Film Silicon Solar Cells



Presented by Subhendu Guha

The global market for solar panels is growing at an annual rate between 20-30%. The workhorse of the industry is the mature single crystal and polycrystal silicon technology. The low material cost of thin film silicon and its manufacturability make it a promising candidate for low-cost production of solar cells. Significant progress has been made in the last several years, and several industries have started expanding their production capacity. At United Solar Ovonic, we use a continuous plasma-CVD process to deposit amorphous silicon multi-junction solar cells on 1.5 mile long rolls of stainless steel. We shall discuss the science and technology for the manufacture of the multi-junction solar cells, and the characteristics of the products.

Subhendu Guha is the Chairman of United Solar Ovonic, world's largest manufacturer of flexible solar laminates. Dr. Guha is an international authority in the science and technology of amorphous silicon alloy solar cells, and has more than 200 publications and over 30 US patents to his credit. His work has received recognition from US Department of Energy (Bright Light Award), *Popular Science Magazine* (Best of what's new), and *Discover Magazine* (Best invention in the Environment Category). He was also the recipient of World Technology Award in the Energy category in 2005.

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Technical Program

Monday Morning, April 21

Hot Topic on High Power Impulse Magnetron Sputtering (HIPIMS)

Moderator: Jolanta Klemberg-Sapieha, *École Polytechnique de Montréal, Canada*

9:30 a.m. JHP-1 Detailed Measurements of the Bombarding Ion Energies in a Pulsed Magnetron Discharge

J.W. Bradley, G.C.B. Clarke, S.A. Voronin, and M. Cada, University of Liverpool, Liverpool, United Kingdom; and P.J. Kelly, Manchester Metropolitan University, Manchester, United Kingdom

9:50 a.m. JHP-2 Deposition Flux Characteristics Near the Substrate in High Power Impulse Magnetron Sputtering (HIPIMS)

A.P. Ehasarian, A. Vetushka, and A. Hecimovi, Sheffield Hallam University, Sheffield, United Kingdom

10:10 a.m. JHP-3 Deposition Rates of High Power Impulse Magnetron Sputtering

Invited 40 min. Talk

A. Anders, Lawrence Berkeley National Laboratory, Berkeley, CA

10:50 a.m. JHP-4 Substrate Heating and Deposition Rate Measurement in a HIPIMS Discharge

G.T. West and P.J. Kelly, Manchester Metropolitan University, Manchester, United Kingdom; J.W. Bradley and G.C.B. Clarke, University of Liverpool, Liverpool, United Kingdom; and P. Ozimek, HUETTINGER Electronic, Sp. z o.o., Zielonka, Poland

11:10 a.m. JHP-5 High Power Impulse Magnetron Sputtering (HIPIMS) on the Industrial Level

G. Greczynski and J. Bohlmark, Chemfilt Ion Sputtering AB, Linköping, Sweden; Y.T. Pei, C.Q. Chen, and J.T.M. De Hosson, University of Groningen, Groningen, The Netherlands; and M. Aulunovic and R. Cremer, CemeCon AG, Wurselen, Germany

11:30 a.m. JHP-6 The Historical Development of HIPIMS Power Supplies: From Laboratory to Production

D. Ochs, HÜTTINGER Elektronik, Freiburg, Germany; P. Ozimek, HUETTINGER Electronic Sp. z o.o., Zielonka, Poland; A. Ehasarian, Sheffield Hallam University, Sheffield, United Kingdom; and R. Spencer, Alacritas Consultancy Ltd., Leicestershire, United Kingdom

Hot Topic on Biomedical and Pharmaceutical Applications of Vacuum Processes and Coatings

Moderator: Hana Baránková, *Uppsala University, Sweden*

9:30 a.m. JB-1 Vacuum Drying Technologies in the Pharmaceutical Industry

Invited 40 min. Talk

E. Jansen, BOC Edwards Pharmaceutical Industry, San Jose, CA

10:10 a.m. JB-2 Low Temperature Alpha Alumina Coatings for Biomedical Implant Applications

A.N. Cloud, University of Arkansas, Fayetteville, AR; S. Canovic, Chalmers University of Technology, Göteborg, Sweden; H.H. Abu-Safe, A. Aryasomayajula, and M.H. Gordon, University of Arkansas, Fayetteville, AR; M. Halvarsson, Chalmers University of Technology, Göteborg, Sweden; and D.G. Bhat, University of Arkansas, Fayetteville, AR

10:30 a.m. JB-3 Fast Integration Treatment (FIT) - A New Nanostructured Titanium Carbide Based Film that Reduces the Osseointegration Time of Surgical Implants

C. Misiano, Romana Film Sottili S.r.l, Rome, Italy; R. Scandurra, University of Roma, Rome, Italy; and P. Matarazzo, Romana Film Sottili S.r.l, Rome, Italy

10:50 a.m. JB-4 ta-C:X for Biomedical Implants

L. Haubold, M. Becker, and T. Schuelke, Fraunhofer USA Center for Coatings and Laser Applications, East Lansing, MI; C. Kleemann, H. Scheibe, and C. Hinueber, Fraunhofer Institute for Material and Beam Technology (IWS), Dresden, Germany; and R. Friedrichs, E. Hoefing, and M. Baumann, Fraunhofer USA Center for Coatings and Laser Applications, East Lansing, MI

11:10 a.m. JB-5 Tantalum Radiopaque Coatings for Stents

D. Glocker and M.M. Romach, Isoflux Incorporated, Rochester, NY

11:30 a.m. JB-6 Evaluation of Titanium and Iridium Based Pacemaker Electrodes Using Electrochemical Impedance Spectroscopy

W. Neff, Wilson Greatbatch Ltd., Clarence, NY

Large Area Coating

Moderator: Michael Andreasen, *NxEdge, Inc.*

9:30 a.m. L-1 A Multidisciplinary Approach Towards Advanced Transparent Conductive Electrodes

B. Szyszka, Fraunhofer Institute for Surface Engineering and Thin Films (IST), Braunschweig, Germany; A. Gombert, Fraunhofer Institute for Solar Energy Systems (ISE), Freiburg, Germany; P. Loebmann, Fraunhofer Institute for Silicate Research (ISC), Wuerzburg, Germany; C. May, Fraunhofer Institute for Photonic Microsystems (IPMS), Dresden, Germany; and C. Elsaesser, Fraunhofer Institute for Mechanics of Materials (IWM), Freiburg, Germany

9:50 a.m. L-2 Optimizing Magnetron Configuration to Sputter Thicker Rotatable Cylindrical Targets

M. Devine, Dexter Magnetic Technologies, Inc., Hicksville, NY; M. Asbas and G. Laverriere, Soleras, Ltd., Biddeford, ME; and M. Schilling, Dexter Magnetic Technologies, Inc., Hicksville, NY

10:10 a.m. L-3 Comparisons of Planar and Cylindrical Magnetrons Operating in Pulsed DC and AC Modes

P.J. Kelly and G. West, Manchester Metropolitan University, Manchester, United Kingdom; Q. Badey, National Polytechnic Institute of Industrial and Chemical Engineering, Toulouse, France; and J.W. Bradley, I. Swindells, and G.C.B. Clarke, University of Liverpool, Liverpool, United Kingdom

10:30 a.m. L-4 Advanced Linear Ion Source for Surface Modification in Large Area Vacuum Deposition Processes

P. Morse, M. George, J.E. Madocks, and J. Morris, General Plasma, Inc., Tucson, AZ

10:50 a.m. L-5 The Impact of the Recent US Supreme Court Decisions and New US Patent and Trademark Office Rules on Patent Acquisition, Exploitation, Enforcement and Defense Strategies

Invited 40 min. Talk

M.M. Zolnick, Esq., J.A. Hynds, Esq., and D.V. Scatrito, Ph.D., Rothwell, Figg, Ernst and Manbeck, P.C., Washington, DC

11:30 a.m. L-6 Investigation of Transparent Conductive Silver Based De-Icing Coatings for Automotive Application

R. Nyderle, T. Preussner and T. Kopte, Fraunhofer-Institut für Elektronenstrahl- und Plasmatechnik (FEP), Dresden, Germany

Vacuum Web Coating

Moderators: Mathias Fahland, *Fraunhofer Institute for Electronics and Plasma Technology (FEP), Germany* and Geoff Ringer, *3M Technical Systems*

9:30 a.m. W-1 A Roll-to-Roll RIE Process for Texturing of Polymer Film Surfaces
D.J. McClure, Acuity Consulting and Training, Siren, WI

9:50 a.m. W-2 Toolset for Confronting the Challenges of R2R Production of Advanced Microelectronics and Displays
M.D. Poliks, Endicott Interconnect Technologies, Inc., Endicott, NY; P. Wickboldt, JEM Enterprises, Inc., Walnut Creek, CA; and B. Sammakia, State University of New York at Binghamton, Binghamton, NY

10:10 a.m. W-3 Novel Heat Source for Brazing Sputtering Targets to Backing Plates
T.P. Weihs and A. Duckham, Reactive Nanotechnologies, Inc., Hunt Valley, MD

10:30 a.m. W-4 Yield Improvement in Metallizing Lines by Using Contact Cleaning Technology
S. Hamilton, Teknek, Ltd., Inchinnan, Scotland, United Kingdom

10:50 a.m. W-5 *In Situ* Patterning for Metal Electrode Thin Film Using Roll Shadow Mask During e-beam Evaporation
Y. Lee, J. Cho and D. Shin, Samsung Electro-Mechanics, Suwon, Korea

11:10 a.m. W-6 PEEK Film and its Properties as a Substrate
M. Percy, Victrex Technology Centre, Thornton Cleveleys, Lancashire, United Kingdom

11:30 a.m. W-7 Biomedical Sensors
H. Saeed, R. Ahmad, and M. Haris, Integral University, Lucknow, Uttar Pradesh, India

Monday Afternoon, April 21

The Donald M. Mattox Lunchtime Tutorial

11:50 a.m.–12:30 p.m. See sidebar on page 7

SVC Exhibit Opens!

Don't miss the only exhibit dedicated to
Vacuum Coating Technologies
12:00 p.m.–7:00 p.m.

Hot Topic on High Power Impulse Magnetron Sputtering (HIPIMS)

Moderator: Arutun P. Ehiasarian, *Sheffield Hallam University, United Kingdom*

2:10 p.m. JHP-7 Research on Promising Applications for High Power Pulse Magnetron Sputtering

Invited 40 min. Talk

V. Sittinger, B. Szyszka, R. Bandorf, M. Vergoehl, and A. Pflug, Fraunhofer Institute for Surface Engineering and Thin Films (IST), Braunschweig, Germany; D.J. Christie, Advanced Energy, Fort Collins, CO; and F.

Ruske, Hahn-Meitner-Institut Berlin, Berlin, Germany

2:50 p.m. JHP-8 Electrical and Optical Properties of Ag Films Deposited by High Power Impulse Magnetron Sputtering

J. Li, S.R. Kirkpatrick, and S.L. Rhode, University of Nebraska-Lincoln, Lincoln, NE

3:30 p.m. JHP-9 Low-Temperature Hydrothermal-Free Reactive Deposition of Alpha-Alumina Coatings Using High Power Impulse Magnetron Sputtering

Sponsored Student Presentation

E. Wallin, Linköping University, Linköping, Sweden; T.I. Selinder, Sandvik Tooling AB, Stockholm, Sweden; and U. Helmersson, Linköping University, Linköping, Sweden

3:50 p.m. JHP-10 Investigation of TiO₂ Thin Films Prepared by Different HIPIMS Processes

M. Vergoehl, R. Bandorf, and P. Giesel, Fraunhofer Institute for Surface Engineering and Thin Films (IST), Braunschweig, Germany; and G. Mark, MELEC GmbH, Ottersweier, Germany

4:10 p.m. JHP-11 Modulated Pulse Power Deposition of Nanometer-Scale Multilayered Coatings

R. Chistyakov and B. Abraham, Zond, Inc. / Zpulser, LLC, Mansfield, MA; W. Sproul, Reactive Sputtering, Inc., San Marcos, CA; and J.J. Moore and J. Lin, Colorado School of Mines, Department of Metallurgical and Materials Engineering, Golden, CO

4:30 p.m. JHP-12 Properties of NiCr Sputtered by HIPIMS in Unipolar and dc-Superimposed Mode

R. Bandorf, S. Falkenau, and K. Schiffmann, Fraunhofer IST, Braunschweig, Germany

4:50 p.m. JHP-13 High Power Pulse Plasma Generator for Modulated Pulse Power Sputtering Processes

R. Chistyakov and B. Abraham, Zond, Inc. / Zpulser, LLC, Mansfield, MA

Hot Topic on Biomedical and Pharmaceutical Applications of Vacuum Processes and Coatings

Moderator: David Glocker, *Isoflux Incorporated*

1:30 p.m. JB-7 Plasma Processing for Implantable Medical Devices

Invited 40 min. Talk

C.E. Taylor, E. Park, and K. Casey, Medtronic, Inc., Minneapolis, MN

2:10 p.m. JB-8 Depositing Liquids for Polymer and Thin Film Coatings used in Medical Devices

W. Sund, Brooks Instruments, Hatfield, VA

2:30 p.m. JB-9 3T3 Fibroblast Cell-Surface Interactions Using Chemical Gradients Formed by Plasma Polymerization

M. Zelzer, The University of Nottingham, Nottingham, United Kingdom; J.W. Bradley, University of Liverpool, Liverpool, United Kingdom; and F.R.A.J. Rose and M.R. Alexander, The University of Nottingham, Nottingham, United Kingdom

Learn and Remember... A Vacuum Wizard's Guide to Understanding Vacuum and Vacuum Coating

Sunday Afternoon, April 20
1:00 p.m.–4:00 p.m.



Your Vacuum Wizard
is **Don McClure**, *Acuity
Consulting and Training*

This half-day event is based on an extensive set of engaging tabletop demonstrations. Many

of the demonstrations use a transparent vacuum chamber, so attendees can “see” the principles of vacuum coating in action. The goals of this event are to make selected concepts related to vacuum and vacuum coating *seen* and *remembered*. This in turn provides a path to deeper *understanding*. Attendees will be offered highly accessible and thought provoking demonstrations and/or descriptions of the essential elements and principles of vacuum, vacuum processing and vacuum coating. The presentation is suitable for both non-technical and technical attendees. The only prerequisite is curiosity about our amazing world.

This presentation provides the attendee with *memorable* experiences related to:

- *pressure and vacuum*
- *vacuum pumps (the many ways a vacuum wizard produces “good” vacuum levels)*
- *vacuum measurement methods (how vacuum wizards know the vacuum level in a container)*
- *very high temperatures (and the magic of making coatings by evaporation)*
- *very low temperatures (and the magic of cryopumping)*
- *how materials change from solid to liquid to gas and back (more vacuum coating magic)*
- *what the “mean free path” is (and why vacuum wizards care)*
- *why low pressures are needed to make pure coatings (and why the “low” pressures needed can be so different in different applications)*

There is no charge to attend this Special Event! Everyone is welcome—conference registrants, exhibitors, short course attendees, students, and teachers. However, the number of attendees is limited so that everyone can see the demonstrations. Register using the SVC On-line TechCon registration form. Then it is first come—first seated.

SVC Brings Outstanding Students to the 2008 TechCon

The SVC Student Sponsorship Committee is pleased to sponsor four students who will present their work in the oral technical sessions.

Introducing these students:

Erik Wallin

Linköping University, Linköping, Sweden
Erik Wallin will present the paper titled "Low-Temperature Hysteresis-Free Reactive Deposition of Alpha-Alumina Coatings using High Power Impulse Magnetron Sputtering" (JHP-9) on Monday afternoon, April 21 at 3:30 p.m.

Adele Packer

Manchester Metropolitan University, Manchester, United Kingdom
Adele Packer will present the paper titled "The Effect of Defined Surface Topography on the Retention of Microorganisms" (JB-13) on Monday afternoon, April 21 at 4:50 p.m.

Hong-Ying Lin

University of Delaware, Newark, DE
Hong-Ying Lin will present the paper titled "Band Gap Reduction of Titanium Dioxide by Titanium Nitride Oxidation" (CT-12) in the Cleantech Symposium - Photocatalysis and Photovoltaics session, on Wednesday afternoon, April 23 at 2:50 p.m.

Salim Hassani

École Polytechnique, Montréal, Canada
Salim Hassani will present the paper titled "Predictive Tools for the Design and Optimization of Erosion Resistant Coating Systems" (T-5) on Wednesday afternoon, April 23 at 1:30 p.m.

2:50 p.m. JB-10 Influence of Chemical Composition and Structure on the Blood Compatibility of Titanium Oxide Films Prepared by E-beam Evaporation

L. Zeng and B. Dechun, Northeastern University, Shenyang, China; and I. Lee, Yonsei University, Seoul, Korea

3:30 p.m. JB-11 Tutorial on Biobased and Biodegradable Plastic Films - New Substrates for Vacuum Coating and Related Technologies

Invited 40 min. Talk

R. Narayan, Michigan State University, East Lansing, MI

4:10 p.m. JB-12 Deposition of Polymer Films by Sputtering for Bio-Applications

Invited 40 min. Talk

E. Kusano and T. Oya, Kanazawa Institute of Technology, Hakusan, Japan

4:50 p.m. JB-13 The Effect of Defined Surface Topography on the Retention of Microorganisms

Sponsored Student Presentation

A. Packer, P. Kelly, K. Whitehead, and J. Verran, Manchester Metropolitan University, Manchester, United Kingdom

5:10 p.m. JB-14 Antimicrobial Effects of Modular Atmospheric Microwave-Driven Plasma Sources

J. Ehlbeck, R. Brandenburg, T. von Woedtke, U. Krohmann, M. Stieber, and K.D. Weltmann, INP Greifswald, Greifswald, Germany

TBD JBFT-1 ToF-SIMS - A Chemical Microscope/Surface Mass Spectrometer for the Biomedical Industry

A. Schnieders and L. Sun, Tascon USA, Inc., Chestnut Ridge, NY

This is a Guaranteed Biomedical and Pharmaceutical Applications Flexible Time (JBFT) presentation; it will be presented in place of a cancelled paper earlier in this session if such situation arises.

Poster Presentations

4:30 p.m.-7:00 p.m. in the Exhibit Hall

Poster-1 Low-Frequency Noise Characteristics of Epitaxial ZnO Photoconductive Sensors
S. Chang, C. Lu, and S. Change, National Cheng Kung University, Tainan City, Taiwan

Poster-2 Tribological Studies of Titanium Nitride Coatings Deposited by Combined Pulsed Magnetron Sputtering and Pulsed Biasing

Z. Liu and P.J. Kelly, Dalton Research Institute, Manchester Metropolitan University, Manchester, United Kingdom; and R.D. Arnell, University of Central Lancashire, Preston, United Kingdom

Poster-3 An 18-inch Closed-Drift Linear Ion Source for DLC and Optical Thin Film Deposition

J.E. Yehoda and S.J. Finke, Morgan Advanced Ceramics: Diamonex Products Division, Allentown, PA

Poster-4 Influence of Deposition Conditions on Mechanical Properties of Optical Coatings Prepared by Electron Beam Evaporation

T. Inomata, Opto-Soltec, Inc. Toride, Ibaraki,

Japan; K. Muro, Utsunomiya University, Utsunomiya, Tochigi, Japan; T. Aoki, Opto-Soltec, Inc., Toride, Ibaraki, Japan; and S. Ogura, Kobe Design University, Kobe, Hyogo, Japan

Poster-5 Plasma Enhanced CVD and Plasma Chemical Etching at Atmospheric Pressure for Continuous Processing of Crystalline Silicon Solar Wafers

E. Lopez, B. Dresler, G. Maeder, S. Krause, I. Dani, and V. Hopfe, Fraunhofer Institute for Material and Beam Technology (IWS), Dresden, Germany; et al.

Poster-6 Design and Fabrication of a Resistance-Switching Memory Device

N. Vickers, W. Dunn, M. Jain, R.N. Savage, and F. Wang, Cal Poly State University, San Luis Obispo, CA

Poster-7 Tribo-Corrosion Properties of Cr-Si-N Coatings on Metal Substrates

M. Benkahoul, E. Bousser, M. Azzi, P. Robin, L. Martinu, and J.E. Klemberg-Sapieha, École Polytechnique, Montréal, Canada

Poster-8 Optical Properties of Transparent Polymer Polycarbonate Modified by Low Temperature Argon/Oxygen Ion Beam Treatment

Y. Yan and Y. Wang, Beijing Institute of Aeronautical Materials, Beijing, China

Poster-9 TiAlN Films Deposited by AC Reactive Magnetron Sputtering

G.C. Vandross, H.H. Abu-Safe, D.G. Bhat, and M.H. Gordon, University of Arkansas, Fayetteville, AR; and K. Abu-Shgair, Al-Balqa University, Al-Balqa, Jordan

Poster-10 Effect of the Cathode Flow-Distributor Channels Geometry on the Performance of PEM Fuel Cell

Y. Saboohi, A. Nozad, and A. Qaffari, Sharif University, Tehran, Iran

Poster-11 Luminous Efficiency Increase through Uneven Surfaces in a Microcell Discharge of Plasma Display Panel

A. Khorami and F. Bahmani, IRIB University, Tehran, Iran

Tuesday Morning, April 22 Optical Coating

Moderators: Bryant Hichwa, *Sonoma State University*, Ric Shimshock, *MLD Technologies LLC*, Ulrike Schulz, *Fraunhofer Institut für Angewandte Optik und Feinmechanik (IOF), Germany*, and Robert Sargent, *JDSU*

8:30 a.m. O-1 Advances in Precision Optical Coatings Through the Use of a Fast-Cycle Sputter Coater

Invited 40 min. Talk

R. Sargent, M. Tilsch, G. Ockenfuss, K. Hendrix, M. Grigonis, and A. Bergeron, JDSU, Santa Rosa, CA

9:10 a.m. O-2 Atomic Layer Deposition in Mass Production of Optical Coatings
S. Sneek, Beneq OY, Vantaa, Finland

9:30 a.m. O-3 Plasma Etching and Coating Techniques to Achieve Antireflection Properties in Combination with Additional Surface Functions on Plastic Optics

U. Schulz, I. Wendling, P. Munzert, and N. Kaiser, Fraunhofer Institut für Angewandte

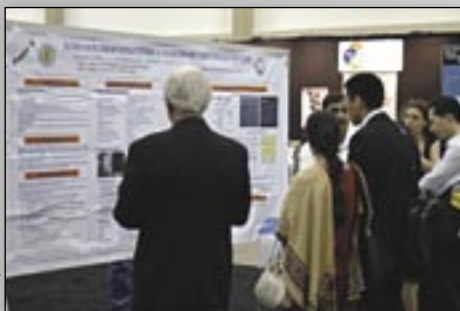


Photo by Limesa Duetter

Poster presentations are on display on Monday from 4:30 p.m.-7:00 p.m. in the Exhibit Hall. See page 6 for a list of presentations in this session. Poster presentations are accepted for the program through March 1, 2008.

Optik und Feinmechanik (IOF), Jena, Germany
9:50 a.m. O-4 Closed Field Magnetron Sputter Deposition of Carbide and Nitrides for Optical Applications
D.R. Gibson, I. Brinkley, E.M. Waddell, and M.J. Walls, Applied Multilayers Ltd., Coalville, United Kingdom

10:30 a.m. O-5 Multilayer Optical Thin Films by Direct Deposition of High-Low Index Materials Utilizing a Closed-Drift Ion Source
J.E. Yehoda, S. Runkle, and S.J. Finke, Morgan Advanced Ceramics: Diamonex Products Division, Allentown, PA

10:50 a.m. O-6 Methods for Improving Optical Coating Quality for E-beam Deposition: Minimizing Deposition Rate Variations and Manufacturing Case Studies
G. Reimann and D. Radgowski, Cybert Materials, LLC, Boston, MA; and M. Gevelber, Boston University, Brookline, MA

11:10 a.m. O-7 Reactive Magnetron Sputter Technologies for Precision Optical and Antireflective Coatings on Glass and Polymer Substrates
H. Bartzsch, P. Frach, K. Lau, and J. Weber, Fraunhofer-Institut fuer Elektronenstrahl- und Plasmatechnik (FEP), Dresden, Germany

11:30 a.m. O-8 Properties of ZrO₂ Optical Thin Films Deposited by Differently Pulsed Reactive Magnetron Processes
M. Vergoehl, P. Giesel, C. Rickers, and O. Werner, Fraunhofer Institute for Surface Engineering and Thin Films (IST), Braunschweig, Germany

11:50 a.m. O-9 Deposition of SnO₂-ZnO Composite Films on Polyethylene Terephthalate Substrate Prepared by ECR-MOCVD
J.H. Park, D.J. Byun, and J.K. Lee, Korea Institute of Science and Technology, Seoul, South Korea

TBD OFT-1 Ti-B-N and Ti-B-O Scratch Resistant Weakly Conductive Transparent Coatings for Aerospace Applications
M. Ersoy and P. Hambourger, Cleveland State University, Cleveland, OH

This is a Guaranteed Optical Coating Flexible Time (OFT) presentation; it will be presented in place of a cancelled paper earlier in this session if such situation arises.

Vacuum Web Coating

Moderators: Hazel Assender, *University of Oxford, United Kingdom* and Greg Tullo, *SE Associates, Inc.*

8:30 a.m. W-8 Direct Printing of Transparent Conducting ITO Patterns for Display Applications
J. Puetz, Leibniz-Institut fuer Neue Materialien - INM, Saarbruecken, Germany

8:50 a.m. W-9 GZO - New Material for TCO on Polymeric Films and Glass
V. Kozlov and E. Machevskis, Sidrabe, Inc., Riga, Latvia

9:10 a.m. W-10 Alternative Transparent Conductive (TCO) Oxides to ITO
Invited 40 min. Talk
C. Bright, 3M Company, Tucson, AZ

9:50 a.m. W-11 Transparent Conductive Electrodes for Flexible Solar Cells
M. Fahlend, T. Vogt, W. Schoenberger, J. Fahlteich, and N. Schiller, Fraunhofer-Institut fuer Elektronenstrahl- und Plasmatechnik (FEP), Dresden, Germany

Large Area Coating

Moderator: Johannes Strümpfel, *VON ARDENNE Anlagentechnik GmbH, Germany*

8:30 a.m. L-7 Practical Measurements of Film Thickness Uniformity
P. Greene and S. Nadel, Applied Materials, Fairfield, CA

8:50 a.m. L-8 Flexible Large Area Production of Optical Multilayer Stacks on Metal Strips
C. Deus, H. Obst, and D. Schulze, VON ARDENNE Anlagentechnik GmbH, Dresden, Germany

9:10 a.m. L-9 High Performing, Flexible and Comprehensive Rotating Cylindrical Sputter Hardware Solutions
A. Blondeel, I. Van de Putte, and W. De Bosscher, Bekaert Advanced Coatings N.V., Deinze, Belgium

9:30 a.m. L-10 Comparison of Mid Frequency and Bipolar Pulsed DC Power Supplies for Dual Magnetron Sputtering
D. Ochs, HÜTTINGER Elektronik, Freiburg, Germany; P. Ozimek and A. Klimczak, HUETTINGER Electronic Sp z o.o., Zielonka, Poland; and T. Rettich, HUETTINGER Elektronik, Freiburg, Germany

9:50 a.m. L-11 New Developments of Plasma Activated High-Rate Electron Beam Evaporation for Large Surfaces
C. Metzner, H. Morgner, J.P. Heiness, and B. Scheffel, Fraunhofer-Institut fuer Elektronenstrahl- und Plasmatechnik (FEP), Dresden, Germany

10:30 a.m. L-12 Defect Counting and Analysis System for Large Area Coating Operations
R. Allen, Thin Film Services, West Bath, ME

10:50 a.m. L-13 Issues and Solutions for Dealing with a Highly Capacitive Transmission Cable
E.N. Morgan and K.C. Cameron, Advanced Energy Industries, Inc., Fort Collins, CO

11:10 a.m. L-14 Arc Prevention in Magnetron Sputtering Processes
D. Carter, Advanced Energy Industries, Fort Collins, CO

11:30 a.m. L-15 Optical and XRR Methods for Analysis and Design of Low-E Coatings and PDP Filters
S. Ulrich, A. Pflug, and B. Szyszka, Fraunhofer Institute for Surface Engineering and Thin Films (IST), Braunschweig, Germany

Plasma Processing

Moderator: James Bradley, *University of Liverpool, United Kingdom*

8:30 a.m. P-1 Optical Emission and Langmuir Probe Studies in a Deep Reactive Ion Etching (DRIE) System
S.P. Koirala, I.U. Abhulimen, M.H. Gordon,

The Donald M. Mattox Tutorial Program

Principles and Perspectives of Atmospheric Thermal Plasmas for Coating

Monday Afternoon, April 21

11:50 p.m. -12:30 p.m.

Presenter: Joachim Heberlein, University of Minnesota



The principal advantage of atmospheric pressure plasmas for materials processing is the high energy density that allows fast processing rates combined with

improved control over the atmosphere compared to combustion based processes. Two thermal plasma coating technologies will be discussed: (1) thermal plasma spray technologies (including plasma spraying and wire arc spraying), and (2) thermal plasma chemical vapor deposition. Industrial applications for thermal plasma spray coatings are steadily expanding as the controls over the process keep improving, and as new process varieties are emerging offering special coating properties. Thermal plasma CVD offers relatively high deposition rates, however, the coating quality remains tied to relatively high substrate temperatures or very high rates of heat removal from the substrate, limiting the applications of the technology. Some relatively new developments will be mentioned in which an atmospheric pressure plasma is expanded into a reduced pressure chamber, leading to a coating process which can combine plasma spraying and thermal plasma CVD. Such a process is of interest when nanophase coatings shall be deposited.

J.V.R. Heberlein received a Diploma in Physics from the Technical University Stuttgart, Germany, and a Ph.D. degree in Mechanical Engineering from the University of Minnesota in 1966 and 1975, respectively.

From 1975 to 1989 he was at the Westinghouse R&D Center involved in a variety of plasma related applications, including as manager for Applied Plasma Research. Since 1989 he has been at the Mechanical Engineering Department at the University of Minnesota working in the areas of plasma heat transfer, electrode effects, plasma instabilities and various plasma process developments, in particular for plasma deposition of special coatings and for nanoparticle synthesis. He has authored or co-authored more than 280 publications and 6 book chapters, and holds 12 patents. He was awarded the grade of Fellow by ASM International, and was elected to the Thermal Spray Hall of Fame of the Thermal Spray Society.



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House of Blues

This year we invite everyone to enjoy a night of live music and dining at the **Chicago House of Blues** networking event on Monday evening from 7:30–10:30 p.m. The House of Blues (HOB) is a multi-faceted entertainment mecca that is home for live music and southern-inspired cuisine, with an atmosphere that celebrates African-American culture, specifically blues music and the largest collection of eclectic folk art.

Located on the river (within walking distance of the Hyatt) and in the unmistakable Marina City complex, House of Blues Chicago is midpoint between the State Street Theatre district and two blocks from the Magnificent Mile.

Cost is just \$48 per person and includes dinner and live entertainment.

Space is limited, so reserve your tickets when you register for the TechCon. See the Special Events box on the registration form on page 31 or on-line at www.svc.org.



H.H. Abu-Safe, and S.L. Burkett, University of Arkansas, Fayetteville, AR

8:50 a.m. P-2 Measurement of Absolute Argon Excited State Populations and EEDFs in an Ar - a-Si Plasma

K.A. Herring, S.L. Mensah, S.K. Koirala, H.H. Abu-Safe, and M.H. Gordon, University of Arkansas, Fayetteville, AR

9:10 a.m. P-3 Feedback Control of the Energy Distribution of Bombarding Ions During Plasma Processing

Invited 40 min. Talk

A. Wendt, University of Wisconsin-Madison, Madison, WI

9:50 a.m. P-4 Atmospheric Pressure Glow Discharge for the Deposition of Silica-Like Films on Polymeric Webs

S. Starostine and M. Creatore, Eindhoven University of Technology, Eindhoven, The Netherlands; H. de Vries, Fujifilm TRL, Tilburg, The Netherlands; and M.C.M. van de Sanden, Eindhoven University of Technology, Eindhoven, The Netherlands

SVC Exhibit Opens!

Don't miss the only exhibit dedicated to Vacuum Coating Technologies
10:00 a.m.–5:00 p.m.

Innovators Showcase

The Innovators Showcase presentations will be presented in the Exhibit Hall starting at 10 a.m. when the Exhibit opens.

Moderator: Frank Zimone, *Reactive Nano-Technologies, Inc.*

IS Reduction of Arc Energy by Retracting Energy Stored in Lead Inductance

R. Bugyi, A. Klimczak, and P. Ozimek, HUETTINGER Electronic Sp. z o.o., Zielonka, Poland

IS Influence of the Voltage Rise Time on High Power Pulse Magnetron Discharge
R. Chistyakov, Zond Inc. / Zpulsor LLC, Mansfield, MA

IS A Technical Walk-Through of an Innovative New Temperature Controlled Capacitive Diaphragm Gauge Family
C. Berg, INFICON AG, Balzers, Principality of Liechtenstein

IS Corrosion Properties of Diamond-Like Carbon Films Deposited Using a Novel PACVD Internal Coating Method

B. Boardman, A. Tudhope, D. Upadhyaya, T. Casserly, M. Gupta, and K. Boinapally, Sub-One Technology, Inc., Pleasanton, CA

IS P+ - Hard Material Coating Technology - an Effective Process for Deposition of Films with Improved Properties

M. Falz, M. Holzherr, and T. Schmidt, VTD Vakuumtechnik Dresden GmbH, Dresden, Germany

Tuesday Afternoon, April 22

Plasma Processing

Moderator: Dave Christie, *Advanced Energy Industries, Inc.*

1:30 p.m. P-5 Controlling the Incident Ion Energy at Substrate Surfaces
S.G. Walton, E.H. Lock and R.F. Fernsler, U.S. Naval Research Laboratory, Washington, DC

1:50 p.m. P-6 Ion Flux Measurements in a Remote Depositing Plasma Using a Pulse Shaped Capacitive Probe

M.C. Petcu, A.C. Bronneberg, M. Creatore, and M.C.M. van de Sanden, Eindhoven University of Technology, Eindhoven, The Netherlands

2:10 p.m. P-7 An Investigation into the Properties of a Dual Source Pulsed Magnetron Sputtering System

G.C.B. Clarke and J.W. Bradley, University of Liverpool, Liverpool, United Kingdom; and G.T. West and P.J. Kelly, Manchester University, Manchester, United Kingdom

2:30 p.m. P-8 Langmuir Probe Investigation of the Effect of Pressure and Hydrogen Concentration in an Ar-H-Si Plasma

S.L. Mensah, H.H. Abu-Safe, D.G. Bhat, and M.H. Gordon, University of Arkansas, Fayetteville, AR

2:50 p.m. P-9 Characterisation of Nano-Coatings Deposited Using an Aerosol Assisted Atmospheric Pressure Plasma Jet Technology

C. O'Sullivan, Dow Corning Plasma Solutions, Cork, Ireland; J. Albaugh, Dow Corning Corporation, Midland, MI; and L. O'Neill, Dow Corning Plasma Solutions, Cork, Ireland

SVC Exhibit Beer Blast!

3:30 p.m.–5:00 p.m.

Tuesday Evening, April 22

HEURÉKA! Post-Deadline Recent Developments Session

Moderators: Hana Baránková and Ladislav Bárdos, *Uppsala University, Sweden*

Abstract Deadline is March 1, 2008 for publication of Abstract in the Final Program

Wednesday Morning, April 23

Technology Forum Breakfasts

Facilitator-led round-table discussions provide an opportunity for informal discussion and interaction on specific subjects. The following topics will be discussed over breakfast on Tuesday or Wednesday morning at 7:00 a.m. The facilitators and their topics will be announced on the SVC Web Site at www.svc.org.

Fuel Cells; Flexible Electronics; Atmospheric Plasmas; Optical Monitoring and Process Control; Tribological Coatings; Plasma Processing and Biomaterials; Process Modeling; Optical Design; Smart Materials; High-Power Impulse Magnetron Sputtering (HIPIMS); Emerging Technologies; Photovoltaics (PV) Investigations; N- and P-type Transparent Conductive Coatings; Magnetron Sputtering; Diamond-Like Coatings; and Plasma Nitriding.

Vacuum Web Coating

Moderators: James McShane, *Avery Dennison* and Charles A. Bishop, *C.A. Bishop Consulting, Ltd., United Kingdom*

8:30 a.m. W-12 Rotatable Magnetron Sputter Technology for Large Area Webcoaters

Invited 40 min. Talk

P. Persoone, NV Bekaert SA, Zwevegem, Belgium and W. De Bosscher, Bekaert Advanced Coatings, Dienze, Belgium

9:10 a.m. W-13 Sputtered Ultra High Gas Barrier AlO_x Layers

H. Assender, H. Suttle, and J. Topping, University of Oxford, Department of Materials, Oxford, United Kingdom

9:30 a.m. W-14 A New Development in Clear Barrier Coatings

S. Jahromi, DSM Licensing Center, Urmond, The Netherlands

9:50 a.m. W-15 The Calcium Test as a Tool for Evaluating the Performance of Flexible Barrier Films

S. Louch and S. Edge, Centre for Process Innovation, Redcar, United Kingdom

10:30 a.m. W-16 Mechanical and Barrier Properties of Thin Oxide Films on Flexible Polymer Substrates

J. Fahlteich, W. Schoenberger, B. Meyer, M. Fahland, and N. Schiller, Fraunhofer-Institut fuer Elektronenstrahl- und Plasmatechnik (FEP), Dresden, Germany

10:50 a.m. W-17 Study of Transparent High Gas Barrier Film and the Evaluation Method of Water Vapor Transmission Rate (WTR)

M. Otsuka, S. Yoshida, C. Okawara, T. Hachisuka, and T. Matsui, Mitsubishi Plastics, Inc., Ushiku, Japan

11:10 a.m. W-18 Large Area PECVD Coatings Using Linear Electron Beam Curtains

A. Yializis and G. Goodyear, Sigma Technologies International, Tucson, AZ; and S.G. Walton, Physics Division, U.S. Naval Research Laboratory, Washington, DC

11:30 a.m. W-19 Advances in Multi-Layers Coating Processes and Equipment

F. Rimediotti and A. Pagni, Galileo Vacuum Systems, Prato, Italy; and P. Rauegi, Galileo Vacuum Systems, Inc. Alpharetta, GA

11:50 a.m. W-20 Mechanical Properties of SiO_x Coated Semi-Crystalline Polymer Films Characterized by Fragmentation Tests

P. Fayet and G. Rochat, Tetra Pak (Suisse) SA, Romont, Switzerland

12:10 p.m. W-21 High Performance Barrier Films via Vacuum Roll Coating

M. Roehrig, F. McCormick, J. Ramos, A. Nachtigal, S. Finley, J. Pieper, and F. DeRoos, 3M Corporate Research Laboratory, St. Paul, MN

TBD WFT-1 Troubleshooting for Roll-to-Roll Vacuum Coaters - a Beginners Guide
C.A. Bishop, C.A. Bishop Consulting Ltd., Nr. Loughborough, Leicestershire, United Kingdom

This is a Guaranteed Vacuum Web Coating Flexible Time (WFT) presentation; it will be presented in place of a cancelled paper earlier in this session if such situation arises.

Optical Coating

Moderator: James Hilfiker, *J.A. Woollam Co., Inc.*, Ludvik Martinu, *École Polytechnique de Montréal, Canada*, C.L. Bungay, *Lockheed Martin*, and W.M.M. Kessels, *Eindhoven University of Technology, The Netherlands*

8:30 a.m. O-10 Infrared Spectroscopic Ellipsometry for Optical Coating Development and Production

Invited 40 min. Talk

C.L. Bungay and S.R. Tuenge, Lockheed Martin, Orlando, FL

9:10 a.m. O-11 Investigating Subsurface Interfaces of Thin Film Coatings Using Annular Dark Field Scanning Transmission Electron Microscopy

G. Acosta, R. Vanfleet, D. Allred, and R.S. Turley, Brigham Young University, Provo, UT

9:30 a.m. O-12 *In Situ* Spectroscopic Ellipsometry for Atomic Layer Deposition

Invited 40 min. Talk

W.M.M. Kessels, Eindhoven University of Technology, Eindhoven, The Netherlands

10:30 a.m. O-13 Reflectance Standards in the Vacuum UV: Cleaning/Storage Considerations

E. Strein, Z. Strother, N.F. Brimhall, S.B. Mitchell, J. Becar, and D.D. Allred, Brigham Young University, Provo, UT

10:50 a.m. O-14 Structural Comparison of GdF₃ Films Grown on CaF₂ (111) and SiO₂ Substrates

J. Wang and H. Schreiber, Corning Tropol Corporation, Fairport, NY; and R.W. Davis and B.R. Wheaton, Corning, Inc., Corning, NY

11:10 a.m. O-15 Thermo-Mechanical Characteristics of Niobium Oxide Optical Thin Films Deposited by Dual Ion Beam Sputtering

E. Cetinorgu, B. Baloukas, J.E. Klemberg-Sapieha, and L. Martinu, École Polytechnique de Montréal, Montréal, Canada

11:30 a.m. O-16 The Optical and Electrical Properties of AZO Films Deposited at Room Temperature

Y.H. Lin, J.C. Hsu, Y.Y. Chen, and H.L. Chen, Fu Jen Catholic University, Taiwan, R.O.C.

11:50 a.m. O-17 Luminescence Efficiency and Optical Property of CsI and NaI Films

H.L. Chen and J.C. Hsu, Fu Jen Catholic University, Taiwan, R.O.C.

The Donald M. Mattox Tutorial Program

Pick up a lunch and join the Tutorial!

Chromogenics: From Motorcycle Helmets to Energy Efficient Buildings

Wednesday Afternoon, April 23
12:30 p.m. -1:10 p.m.

Presenter: Claes G. Granqvist, The Angstrom Laboratory, Uppsala University, Sweden



Chromogenic thin films can change their optical properties upon light exposure, heating, or electrical charging. This talk will give a popular overview of these new

technologies with emphasis on electrochromics, i.e., devices that can be viewed as thin-film batteries whose charging state shows up as optical absorption. Simple descriptions of functional principles will be followed by discussions of a number of emerging technologies for applications ranging from variable-transparency helmet visors for safe motorcycle riding to "smart windows" and glass facades in buildings with improved energy efficiency and large indoors comfort.

Claes-Göran Granqvist has been Professor of Solid State Physics at the Department of Engineering Sciences, The Ångström Laboratory, Uppsala University, Sweden, since 1993. He was formerly Professor of Experimental Physics at Gothenburg University, Sweden, in 1989-1993. Granqvist's research during the past several years has covered materials, mostly PVD-deposited thin films, for energy efficiency and solar energy applications particularly in the built environment. Variable-transmittance "smart" windows is one example, which also forms the basis of Chromogenics Sweden AB, a company founded by Granqvist and his collaborators and presently employing some 15 persons. Other research interests include nanoscience and sensor science. Granqvist has published more than 630 scientific papers and many books and proceedings volumes. He has an Honorary Doctorate from UNI (Lima, Peru), is fellow of SPIE, is honorary member of the Indian Materials Society, and member of the Royal Swedish Academy of Science and The Royal Swedish Academy in Engineering Sciences.

Thank You!

The SVC would like to thank the companies sponsoring the following events at the 2008 TechCon in Chicago.

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“Meet the Experts” Corner

Monday, Tuesday and Wednesday

The popular “Meet the Experts” Corner will once again provide an informal setting for conference registrants to obtain answers to their vacuum coating problems. A team of experts will be available to answer questions relating to general thin film deposition issues. TechCon attendees are invited to contact SVC at svcinfo@svc.org to suggest topics of specific interest.

A list of experts, discussion topics, and a schedule will be announced on the SVC Web Site and in the Final Program.

Symposium on Cleantech Energy Conversion and Storage

Organic Photovoltaics

Moderator: Frederik C. Krebs, *Risø National Laboratory, Denmark*

8:30 a.m. CT-1 Towards the Optimization of Polymer-Fullerene Composite Solar Cells

Invited 40 min. Talk

B. C. Thompson and J.M.J. Frechet, University of California - Berkeley, Berkeley, CA

9:10 a.m. CT-2 Fully Printed Long Lived Organic Solar Cell Modules

G. Dennler, C. Waldauf, P. Denk, K. Forberich, T. Ameri, M.C. Scharber, S.A. Choulis, J. Hauch, E. Zeira, and C.J. Brabec, Konarka Austria GmbH, Linz, Austria

9:30 a.m. CT-3 Processing of Polymers for Plastic Solar Cells

F.C. Krebs, Risø National Laboratory, Roskilde, Denmark

9:50 a.m. CT-4 Degradation Mechanisms in Polymer Solar Cells

K. Norrman and F.C. Krebs, Risø National Laboratory, Roskilde, Denmark

Large Area Coating

Moderators: Michael Andreasen, *NxEdge, Inc.* and Bernd Szyszka, *Fraunhofer Institute for Surface Engineering and Thin Films (IST), Germany*

10:30 a.m. CT-5 Progress of Thin Film Silicon PV Developments

Invited 40 min. Talk

J. Meier, Oerlikon Solar-Lab S.A., Neuchatel, Switzerland

11:10 a.m. CT-6 High Rate Electron Beam Evaporation of Functional Layers for Solar Cells

E. Reinhold, J. Faber, M. Hofmann, and S. Mosshammer, VON ARDENNE Anlagentechnik GmbH, Dresden, Germany

11:30 a.m. CT-7 Hydrogenated SiN for Anti-Reflection and Passivation of Crystalline Silicon Solar Cells by New PECVD Source

M.A. George, P. Morse, H. Chandra, and J.E. Madocks, General Plasma, Tucson, AZ

11:50 a.m. CT-8 Process Power Supplies for Solar Cell Production

D. Ochs and **T. Rettich**, HÜTTINGER Elektronik, Freiburg, Germany

12:10 p.m. CT-9 On the Control of Film Growth of Plasma-Enhanced Chemical Vapor Deposited ZnO:Al for Thin Film Photovoltaics

M. Creatore and I. Volintiru, Eindhoven University of Technology, Eindhoven, The Netherlands; C.I.M.A. Spee, TNO Science and Industry, Materials Technology, Eindhoven, The Netherlands; and M.C.M. van de Sanden, Eindhoven University of Technology, Eindhoven, The Netherlands

Tribological & Decorative Coating

Moderators: Gary Doll, *Timken Research* and Jolanta Klemberg-Sapieha, *École Polytechnique de Montréal, Canada*

8:30 a.m. T-1 Effect of Ion Beam Conditions and Interlayer on the Formation of Diamond-Like Carbon Films

J.I. Jeong, and J.H. Yang, Research Institute of Industrial Science and Technology, Pohang, Gyongbuk, Korea; and Y.H. Park and K.H. Lee, Research Institute of Industrial Science and Technology, Ulsan, Korea

8:50 a.m. T-2 The Effect of Cu Additions on the Structure and Properties of CrCu(N) Nanocomposite Coatings

K. Polychronopoulou, University of Cyprus, Nicosia, Cyprus; N. Demas, University of Illinois, Urbana, Illinois; M.A. Baker, University of Surrey, Guildford, United Kingdom; E. Spain, J.C. Avelar-Batista and J. Housden, Tecvac Ltd., Cambridge, United Kingdom; A.A. Polycarpou, University of Illinois, Urbana, Illinois; and R. Claus, University of Cyprus, Nicosia, Cyprus

9:10 a.m. T-3 Nano and Micro Indentation and Scratch Tests of Mechanical Properties of Thin Films

N. Gitis, I. Hermann, and S. Kuiry, Center for Tribology, Inc., Campbell, CA

9:30 a.m. T-4 A Cathode Design for the Application of Cylindrical Sputter Targets to Decorative and Tribological Deposition Processes

A. Plaisted, Soleras Ltd., Biddeford, ME

Plasma Processing

Moderator: Mariadriana Creatore, *Eindhoven University of Technology, The Netherlands*

10:30 a.m. P-10 Improving the Emptying Behaviour of Packaging via Coating their Surfaces with Plasma-Polymerized Nanoscale Layers

F. Loibl, C. Holtz, and H.C. Langowski, Technical University of Munich, Freising-Weihenstephan, Germany

10:50 a.m. P-11 ta-C:X - Depositing Doped Superhard Amorphous Carbon Films Using the LaserArco PVD Platform

L. Haubold, M. Becker, D. Packer, and T. Schuelke, Fraunhofer USA Center for Coatings and Laser Applications, East Lansing, MI

11:10 a.m. P-12 RF Plasma Enhanced Cylindrical Magnetron Sputter Deposition

R. Wei, Southwest Research Institute, San Antonio, TX; and S.L. Lee, US Army Armament Research and Development Engineering Center, Watervliet, NY

Wednesday Afternoon, April 23

The Donald M. Mattox Lunchtime Tutorial

12:30 p.m.–1:10 p.m. See sidebar on page 9

Emerging Technologies

Moderators: Hana Baránková, *Uppsala University, Sweden* and Carlo Misiano, *Romana Film Sottili S.r.l., Italy*

1:30 p.m. E-1 Atmospheric Pressure Plasmas for Crystalline Silicon Photovoltaics

Invited 40 min. Talk

V. Hopfe, Fraunhofer Institute for Material and Beam Technology (IWS), Thin Film Technology, Dresden, Germany; and D.W. Sheel, Salford University, Manchester, United Kingdom

2:10 p.m. E-2 Pulsed Bias PVD of Crystalline Chromia and Alumina Films at Low Temperature

M. Audronis, A. Matthews, and A. Leyland, The University of Sheffield, Sheffield, United Kingdom

2:30 p.m. E-3 Growth of Gallium Nitride Semiconductor Materials by Plasma Sputtering
D. Baldwin, 4Wave, Inc., Sterling, VA; J.P. Timler, Glacier Semiconductor, Metairie, LA; and D. Jena, University of Notre Dame, Notre Dame, IN

2:50 p.m. E-4 Deposition Rate Dependencies and Thickness Profiles from a High Density Plasma Source Sputter System
R. Chow, Z. Demir, and K. Moffitt, Lawrence Livermore National Laboratory, Livermore, CA

3:30 p.m. E-5 Preparation of Photocatalytically Active Layers on Polycarbonate by Magnetron Sputtering
T. Neubert, O. Werner, F. Neumann, and M. Vergoehl, Fraunhofer Institute for Surface Engineering and Thin Films (IST), Braunschweig, Germany

3:50 p.m. E-6 Influence of the Annealing Temperature on the Properties of CrN/Ag and CrSiN/Ag Nano Scale Multilayers Deposited by Reactive Magnetron Sputtering
M. Baraket and D. Mercs, LERMPS/UTBM, Belfort, France; V. Demange, École des Mines, Nancy, France; and C. Coddet, LERMPS/UTBM, Belfort, France

4:10 p.m. E-7 Micro Raman and Cathodoluminescence Spectroscopy of PVD Titania Films
V. Vishnyakov, Manchester Metropolitan University, Manchester, United Kingdom; and N. Mahdjoub, Manchester Metropolitan University, Manchester, United Kingdom

4:30 p.m. E-8 Process Development and Characterization of MEMS Cantilever Structures Based on NiTi Shape Memory Thin Films
R. Savage, Cal Poly State University, San Luis Obispo, CA; D.M. Dequine, KLA-Tencor Corporation, Milpitas, CA; and D. Getchel, NEC Electronics America, Roseville, CA

4:50 p.m. E-9 Environmentally Stable Organic Light Emitting Field Effect Transistors
C. Santato, École Polytechnique de Montréal, Montréal, Canada; F. Cicoira, University of Quebec, Varennes, Canada; H. Meng, Central Research and Development, E.I. DuPont Company, Wilmington, DE; F. Rosei, University of Quebec, Varennes, Canada; and D. Perepichka, McGill University, Montréal, Canada

5:10 p.m. E-10 Molecular Assembly of Rubrene on a Metal/Metal Oxide Nanotemplate
F. Cicoira, Cornell University, Ithaca, NY; J.A. Miwa and F. Rosei, Institut National de la Recherche Scientifique (INRS), Varennes, Canada; and D.F. Perepichka, McGill University, Montréal, Canada

Process Modeling & Control

Moderators: Colin Quinn, *General Plasma, Inc.* and Dan Carter, *Advanced Energy Industries, Inc.*

1:30 p.m. A-1 Gas Flow and Plasma Simulation for Parallel Plate PACVD Reactors
A. Pflug, M. Siemers, and B. Szyszka, Fraunhofer Institute for Surface Engineering and Thin Films (IST), Braunschweig, Germany

1:50 p.m. A-2 Multi-Physics Simulation of Plasma Reactor
K. Shah, ESI US Group, Santa Clara, CA

2:10 p.m. A-3 *In Situ* Broadband Monitoring and Characterization of Thin Films
A. Voronov and F. Placido, University of Paisley, Paisley, United Kingdom; and K. Karstad, Scalar Technologies, Ltd., Livingston, United Kingdom

2:30 p.m. A-4 A Novel EIES Sensor For Real-Time Control of CIGS Processes with Improved Accuracy
C. Lu, Lu Laboratory, Mountain View, CA; and C.D. Blissett and G. Diehl, Sigma Instruments, Fort Collins, CO

2:50 p.m. A-5 *In Situ* Investigation of Surface Oxidation of Ni Metal Film Using Single Wavelength Optical Monitoring
S. Song and F. Placido, University of Paisley, Paisley, United Kingdom

3:30 p.m. A-6 Substrate-Level Diagnostics for Process Modeling and Control

Invited 40 min. Talk

G. Roche and P. MacDonald, KLA-Tencor, Santa Clara, CA

4:10 p.m. A-7 Deposition of Ultra-Thin Oxides on Silicon: Real-Time Film Thickness and Wafer Temperature Measurement
S. Uredat, LayTec GmbH, Berlin, Germany; L. Geelhaar, NaMLab GmbH, Dresden, Germany; and J.T. Zettler, LayTec GmbH, Berlin, Germany

4:30 p.m. A-8 Critical Measurement and Control Issues in Selecting a Quartz Crystal Monitor
D. Radgowski and G. Reimann, Cyber Materials, LLC, Boston, MA; and M. Gevelber, Boston University, Boston, MA

4:50 p.m. A-9 Predicting Functional Reliability in Powered Plasma Processes
R. Heckman, D. Carter and V. Brouk, Advanced Energy Industries, Inc., Fort Collins, CO

Symposium on Cleantech Energy Conversion and Storage

Photocatalysis and Photovoltaics

Moderator: Ludvik Martinu, *École Polytechnique de Montréal, Canada*

1:30 p.m. CT-10 Photochemistry on TiO₂ Surfaces - Fundamental Reaction Kinetics

Invited 40 min. Talk

J.T. Yates, Jr., University of Virginia, Charlottesville, VA



SVC Foundation Sponsors the Third Annual 5K Fun Run and Walk

If you do not mind getting up early before a busy day, the **SVC Third Annual Fun Run and Walk** will be a great experience for all runners and walkers — whatever your ability. About 60 runners and walkers had a great time at the last TechCon.

Want to try it this year? The 3rd Annual 5K Fun Run and Walk will be on Tuesday, April 22 at 6:00 a.m. The run will not only benefit your own health, but also the SVC Foundation, which gives out scholarships to students working in the field of vacuum coating technology.

The Foundation is also looking for Sponsors, who would like to have their company's name and logo on the back of the T-Shirt given to every participant in the event. Please contact Wolfgang Decker at w.decker@vastfilm.com for further information.

The registration fee of \$25 will include a T-shirt. Register for the 5K Run when you register for the TechCon using the SVC On-line Registration system on the SVC Web Site at www.svc.org.

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2:10 p.m. CT-11 Ultra High Rate Deposition of TiO₂ Photocatalyst by Reactive Sputtering

Invited 40 min. Talk

Y. Shigesato, Aoyama Gakuin University, Kanagawa, Japan

2:50 p.m. CT-12 Band Gap Reduction of Titanium Dioxide by Titanium Nitride Oxidation

Sponsored Student Presentation

H. Lin, M. Schulz, K. Demirkan, S.I. Shah, and C.P. Huang, University of Delaware, Newark, DE

3:30 p.m. CT-13 The Role of Vacuum Coatings in Cost-Effective Photovoltaic Technologies

Invited 40 min. Talk

S. Deb, National Renewable Energy Laboratory (NREL), Golden, CO

Smart Windows and Batteries

Moderators: Carl Lampert, *Star Science* and Claes G. Granqvist, *Uppsala University, Sweden*

4:10 p.m. CT-14 High Performance Electrochromic Glazing

Invited 40 min. Talk

P. Letocart, A. Blanchard, and A. Andreau, Saint-Gobain Sekurit Deutschland, Herzogenrath, Germany; E. Valentin, Saint-Gobain Recherche, Aubervilliers, France; and J.C. Giron, Saint-Gobain Sekurit Deutschland, Herzogenrath, Germany

4:30 p.m. CT-15 2008 Study of Architecture Professionals on the Subject of Smart Glass, Daylighting and Clean Technology

G.M. Sottile, Research Frontiers Incorporated, Woodbury, NY

4:50 p.m. CT-16 Electrochromic Device Without a Separate Lithiation Step

E.J. Widjaja, NV Bekaert SA, Zwevegem, Belgium

5:10 p.m. CT-17 Characteristics of C₆₀ Thin Film Coated Silicon Electrodes for Lithium Secondary Batteries

J.K. Lee, Korea Institute of Science and Technology, Seoul, South Korea; O.M. Vovk, Institute for Single Crystals, National Academy of Science of Ukraine, Kharkiv, Ukraine; and B.W. Cho, Korea Institute of Science and Technology, Seoul, South Korea

Tribological and Decorative Coating

Moderators: Papken Hovsepian, *Sheffield Hallam University, United Kingdom* and Lucy Davies, *Caterpillar, Inc.*

1:30 p.m. T-5 Predictive Tools for the Design and Optimization of Erosion Resistant Coating Systems

Sponsored Student Presentation

S. Hassani, J.E. Klemberg-Sapieha, and L. Martinu, Ecole Polytechnique, Montréal, Canada; M. Bielawski and W. Beres, National Research Council Canada, IAR, Ottawa, Canada; and M. Balazinski, Ecole Polytechnique, Montréal, Canada

1:50 p.m. T-6 CrAlCN/CrCN Nanoscale Multilayer PVD Coatings Deposited by the Combined High Power Impulse Magnetron

Sputtering / Unbalanced Magnetron Sputtering, (HIPIMS/UBM) Technology
P. Eh. Hovsepian and A.P. Ehasarian, Sheffield Hallam University, Sheffield, United Kingdom; and U. Ratayski, Technical University of Mining and Technology, Freiberg, Germany

2:10 p.m. T-7 Coatings for Aero Engine Applications

Invited 40 min. Talk

C. Levens, Technical University of Brandenburg at Cottbus, Cottbus, Germany; and A. Kohns and T. Haubold, Rolls-Royce Deutschland Ltd. and Company KG, Oberursel, Germany

2:50 p.m. T-8 New Concept for Production of Tool Coatings Based on Nitrides and Oxides
F. Papa, R. Tietema, and T. Krug, Hauzer Techno Coating BV, Venlo, The Netherlands

3:30 p.m. T-9 Measurement of Carbon Based Film Properties for Automotive Application

Invited 40 min. Talk

J. Vyskocil, HVM Plasma, Prague, Czech Republic

4:10 p.m. T-10 Tribological Properties and Tool Life Evaluation of TiN Coatings with Embedded Solid Lubricants

C.G. Guleryuz, and J.E. Krzanowski, University of New Hampshire, Durham, NH; and G. Fox-Rabinovich, and S.C. Veldhuis, McMaster University, Ontario, Canada

4:30 p.m. T-11 Tribological Properties of Duplex Treated 410 Martensitic Stainless Steel

S. Gurusankar, Ecole Polytechnique, Montreal, Canada; L. Duanjie, Department of Mining, Metals and Materials Engineering, Montreal, Canada; A. Raveh, Gurion University, Beer Sheva, Israel; J. Szpunar, Department of Mining, Metals and Materials Engineering, Montreal, Canada; and J.E. Klemberg-Sapieha and L. Martinu, Ecole Polytechnique, Montreal, Canada

4:50 p.m. T-12 PVD Platform for Plasma Based Deposition for High End Coatings
R. Dielis and P. Collignon, IonBond AG, Olten, Switzerland; and E. Damond, IonBond, Chassieu, France

5:10 p.m. T-13 Superhard Low Friction C-DLC-Coatings Deposited by "Reactive" Sputtering of Graphite

W. Münz, SVS Vacuum Coating Technologies, Karlstadt, Germany

Thursday Morning, April 24 Optical Coating

Moderators: Ron Willey, *Willey Optical Consultants*, Norbert Kaiser, *Fraunhofer Institut für Angewandte Optik und Feinmechanik (IOF), Germany*, J.J. Simon, *TECSEN Laboratory, France* and C. Batista, *University of Portugal, Portugal*

8:30 a.m. O-18 Optical Coating for Organic Solar Cells

Invited 40 min. Talk

J.J. Simon, F. Monestier, P. Torchio, D. Duche, L. Escoubas, and F. Flory, TECSEN Laboratory, Marseille, France

9:10 a.m. O-19 Intelligent Tungsten Doped VO₂ Thermochromic Coatings Prepared by Reactive DC Magnetron Sputtering
C. Batista and V. Teiseira, University of Minho, Braga, Portugal

9:30 a.m. O-20 Broad Band Antireflection Coating on Zinc Sulphide Simultaneously Effective in SWIR, MWIR and LWIR Regions
A. Ghosh and A.S. Upadhyaya, IRDE, Thin Film Lab, Dehra Dun, Uttarakhand, India

9:50 a.m. O-21 New and Improved Interference Security Image Structures Based on Metamerism with Low User and Illumination Sensitivity
B. Baloukas and L. Martinu, École Polytechnique de Montréal, Montréal, Canada

10:30 a.m. O-22 Design of Non-Polarizing Beamsplitters
R.R. Willey, Willey Optical Consultants, Charlevoix, MI

10:50 a.m. O-23 Synthesis of a Variety of Optical Filters Using Rugated Index Profiles
R. Dannenberg, Eclipse Energy Systems, Inc., St. Petersburg, FL

11:10 a.m. O-24 Coatings for Short Wavelengths
N. Kaiser, T. Feigl, S. Yulin, D. Gaebler, and M. Bischoff, Fraunhofer Institute for Applied Optics and Precision Engineering (IOF), Jena, Germany

11:30 a.m. O-25 Wide-Angle, Polarizing Beam-Splitter Coating for Imaging Applications Using Sputter-Deposition Process
R. Bevis and H. Lee, Agilent Technologies, Inc., Santa Clara, CA

11:50 a.m. O-26 Design and Fabrication of Broadband Mirror for MID-IR-OPO Laser (Wavelength region 1.2-2.1 micrometer) with TiO₂ and SiO₂ Materials Using Electron-Beam Evaporation Technique
D. Kumar, L. Dasgupta, and A. Kumar, DRDO, Delhi, India

Tribological & Decorative Coating

Moderators: Hans-Joachim Scheibe, *Fraunhofer Institute for Material and Beam Technology (IWS), Germany* and Wolfgang Diehl, *Fraunhofer Institute for Surface Engineering and Thin Films (IST), Germany*

8:30 a.m. T-14 Hard Amorphous Si-B-C-N Films with Ultra-High Thermal Stability

J. Vlcek, J. Houska, S. Hreben, J. Capek, P. Zeman, and R. Cerstvy, University of West Bohemia, Plzen, Poland

8:50 a.m. T-15 Influence of Silicon Content on the Performance of Multilayer Diamond-Like Carbon Coatings
S. Kumar, N. Goyal, P.N. Dixit and C.M.S. Rauthan, National Physical Laboratory, New Delhi, India; and T. Seth, Centre for Materials for Electronics Technology, Maharashtra, India

9:10 a.m. T-16 The Development of Hydrogen-Free DLC-Coated Valve-Lifter

Invited 40 min. Talk

Y. Mabuchi, T. Hamada, and H. Izumi, Nissan Motor Co., Ltd., Japan; Y. Yasuda, Nissan Motor Co., Ltd., Japan; and M. Kano, Kanagawa Industrial Technology Center, Japan

9:30 a.m. T-17 Applications of Diamond-Ceramic Face Seals Coated with Hot-Filament Activated CVD

L. Schaefer, M. Armgardt, and M. Hoefler, Fraunhofer Institute for Surface Engineering and Thin Film (IST), Braunschweig, Germany; and J. Otschik and A. Schruerfer, EagleBurgmann Industries, Wolfratshausen, Germany

10:30 a.m. T-18 The Developments of Highly Durable Decorative PVD Finishes Using UV Cured Clear-Coats

M. Goldsberry, VacuCoat Technologies, Inc., Clinton Township, MI; and P. Mills, Fusion UV Systems, Inc., Brunswick, OH

10:50 a.m. T-19 Decorative Nano Color Coatings with Enhanced Mechanical and Chemical Properties

M. Belzner and R. Domnick, ARA-Coatings GmbH & Company KG, Erlangen, Bavaria, Germany

11:10 a.m. T-20 DLC Base Coat as Part of Decorative Coating for Scratch Resistant Support on Soft Substrates

P. Peeters, J. Soldan, J. Landsbergen, R. Tietema, and T. Krug, Hauzer Techno Coating BV, Venlo, The Netherlands

11:30 a.m. T-21 New Developments and Trends in Decorative and Functional Vacuum Coatings

R.J. Rodriguez, R. Martinez, M. Rico, and J.A. Garcia, Asociacion de la Industria Navarra, Pamplona, Spain

11:50 a.m. T-22 Wear-Corrosion Study of Tantalum-Oxide Layers Produced by Inductive Radio-Frequency Plasma Anodization of Tantalum



All Attendees, Exhibitors, Presenters, and Visitors must use the On-line Registration System to Register for the Conference and Hotel!

To register, go to the SVC Web Site at www.svc.org. Register on-line for the TechCon and your information is automatically linked to the hotel reservation system where you are guided through a step-by-step reservation process and receive instant confirmation.

Rooms have been reserved for SVC TechCon attendees at the Hyatt Regency Chicago on the River Walk from April 18 through departure on April 24, 2008.

You must register for the TechCon in order to book a room in the SVC room block at this hotel. You are strongly encouraged to make your reservations prior to February 15, 2008 (\$179 for single or double plus prevailing tax). Space is limited, so make your reservations today!

The SVC conference rate is not guaranteed after March 14, 2008. A limited number of rooms at the prevailing government rate are available. (US Government ID will be required at hotel check-in for rooms reserved at the government rate.) All on-line room reservations must be guaranteed by a credit card. Telephone reservations will not be accepted. Cancellations (and modifications) can be made on-line. There will be no cancellation fee for cancellations made on or before 60 days prior to the arrival date.

Remember that you must pay your 2008 Membership Dues before you can register at the "Member Rate" and reserve your room for the Conference. If you wait to renew your membership when you register for the Conference, you will be automatically directed to pay your dues before you can proceed with registration and reserve your hotel room.

Live Product Demonstrations by Vendors in the Exhibit Hall!

We have added Live Product Demonstrations to the program this year as a way to further enhance the visibility of exhibitors and provide a relaxed, hands-on forum for introducing new products or ideas to the attendees. Floor space has been reserved in the Exhibit Hall for Live Product Demonstrations.

Exhibiting companies are invited to submit a title and short **150-word abstract describing a Live Product Demonstration** that they would like to submit for inclusion in the Final Program. **Send the abstract to abstracts@svc.org.**

Provide complete contact information for this submission (company name, contact name, mailing address, phone, FAX, and E-mail). Indicate any utilities and services that your company will need SVC to provide in the demonstration area: power; compressed air; cooling water; square footage of floor space; furnishings



Networking Events Abound at the 2008 TechCon in Chicago

The SVC TechCon is known for providing many opportunities for attendees to meet and interact with each other.

Network at Social Functions

(included in the TechCon registration fee!)

- *Newcomer's Reception*
- *Welcome Reception for TechCon registrants and exhibitors*
- *Exhibit Hall Reception, Lunch and Beer Blast*
- *Technology Forum Breakfasts*

House of Blues Entertainment Event

SVC plans to organize a special evening event at the House of Blues – a Chicago entertainment and dining icon. Contact the SVC Administrative Office if your company would be interested in sponsoring this Special Event.

Technology Forum Breakfast Table Topics

Facilitator-led round-table discussions provide an opportunity for informal discussion and interaction on specific topics. The following topics will be included in the 2008 program:

Fuel Cells; Flexible Electronics; Atmospheric Plasmas; Optical Monitoring and Process Control; Tribological Coatings; Plasma Processing and Biomaterials; Process Modeling; Optical Design; Smart Materials; High Power Impulse Magnetron Sputtering (HIPIMS); Emerging Technologies; Photovoltaics (PV) Investigations; N- and P-type Transparent Conductive Coatings; Magnetron Sputtering; Adhesion and Deadhesion.

"Meet the Experts" Corner

The popular "Meet the Experts" Corner will once again provide an informal setting for conference registrants to obtain answers to their vacuum coating problems. A team of experts will be available to answer questions relating to general thin film deposition issues.



Third Annual 5K Fun Run and Walk

At the 50th Anniversary TechCon in Louisville last April, 25 5K Run sponsors and 68 runners and walkers helped to raise \$9,200 for the SVC Foundation, making the 2nd Annual 5K Fun Run and Walk a success! The SVC is working with Wolfgang Decker once again to plan a 5K Fun Run and Walk for the TechCon in Chicago in 2008. If you are interested in becoming a sponsor to benefit the SVC Foundation, contact Wolfgang Decker at w.decker@vastfilm.com.

A. Raveh, M. Gelbstein, G. Moshe, and M. Weiss, Nuclear Research Center-Negev, Beer Sheva, Israel; and J.E. Klemberg-Sapieha and L. Martinu, École Polytechnique, Montréal, Canada

Plasma Processing

Moderator: Scott Walton, U.S. Naval Research Laboratory

8:30 a.m. P-13 Characterization of the Parameter Space in Expanding Thermal Plasma Systems with Organosilane and Oxygen Reagents

M.A. Gilliam and S.M. Gasworth, Exatec LLC, Wixom, MI

8:50 a.m. P-14 Advances in PECVD Barrier Coating Development for ISBM PP Containers

C. Weikart, The Dow Chemical Company, Midland, MI; T. Glass, H. Pham, and A. Taha, The Dow Chemical Company, Freeport, TX; M. Larive, and T. Fisk, The Dow Chemical Company, Midland, MI; and J. Felts, Nano Scale Surface Systems, Inc., Alameda, CA

9:10 a.m. P-15 Effect on Adhesion of Gas Release from Polymer Surfaces

S. Song and F. Placido, University of Paisley, Paisley, United Kingdom

9:30 a.m. P-16 Investigation of Corrosion Resistance of Mg Alloy Sheets by Glow Discharge Plasma Treatment

J.H. Yang and J.I. Jeong, Research Institute of Industrial Science and Technology, Pohang, Gyeongbuk, Korea; and Y.H. Park and K.H. Lee, Research Institute of Industrial Science and Technology, Bukgu, Ulsan, Korea

9:50 a.m. P-17 Low-Power Remote Plasma Cleaning

C.G. Morgan, XEI Scientific, Inc., Redwood City, CA; J.E. Boulter, University of Wisconsin-Eau Claire, Eau Claire, WI; and R. Vane, XEI Scientific, Inc., Redwood City, CA

10:30 a.m. P-18 Microcavity Plasmas: Physics and Applications

Invited 40 min. Talk

K.H. Schoenbach, Old Dominion University, Frank Reidy Research Center for Bioelectronics, Norfolk, VA

11:10 a.m. P-19 A Novel Plasma Source for Microscopic Plasma Surface Processing

F. Duemmer, S. Wicklein, M. Becker, N. Xi and T. Grotjohn, Fraunhofer USA Center for Coatings and Laser Applications, East Lansing, MI

11:30 a.m. P-20 Plasma Decontamination at Atmospheric Pressure - Basics and Applications

Invited 40 min. Talk

K.D. Weltmann, R. Brandenburg, J. Ehlbeck, U. Krohmann, M. Stieber, and T. v. Woedtke, INP Greifswald, Greifswald, Germany

Chicago 2008



Travel Arrangements



The Society of Vacuum Coaters has selected American Airlines as the Official Airline for our upcoming conference in Chicago, IL in April 2008. To take advantage of discount savings on your airline ticket, travel American round-trip from anywhere to Chicago, IL between April 12 and May 1, 2008.

American is offering 5% off the lowest published fare—or is offering Zone fares that are discounted off Y fares. For Zone Fares, a seven-day

advance purchase and a two night minimum stay are required—Zone fares are based on Origin and Destination.

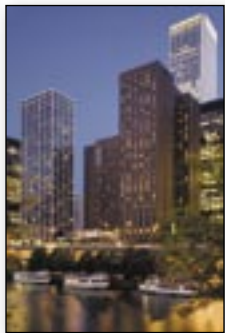
The \$10 booking fee by phone can be avoided by booking on-line at www.aa.com. After selecting flights, place the SVC Authorization number (A7148AW) in the AA.com discount code box located on the Passenger Detail page to obtain the discount.

You or your Travel Agent can call and book a special Directional Zone Fare between 7:00 a.m. and midnight every day. Ensure that the American agent documents your passenger record with SVC's Authorization #A7148AW. There is no requirement for a Saturday-night stay. Check with American Airlines to find the discount fare that best suits your needs! (You will be confirmed at the lowest applicable fare, providing tariff rules are met.)

For reservations, visit www.aa.com or call American Airlines Meeting Services today at 1-800/433-1790 and reference SVC's Authorization #A7148AW. Call EARLY since seats are limited and restrictions may apply.

SVC Companions!

Join us as we "make no little plans" to explore Chicago!



Experience the heartbeat of Illinois at the Hyatt Regency Chicago. Connected to Illinois Center, this Four Diamond downtown Chicago hotel is ideally situated within the Magnificent Mile, an American version of the Champs-Élysées. Immerse yourself in the "city within a city," as this downtown Chicago hotel links you to Blues, Jazz, irresistible cuisine, Grant and Millennium Parks, Lake Michigan beaches, Navy Pier and Michigan Avenue.

You'll find dozens of attractions, including museums, shopping on Michigan Avenue, and architectural tours by trolley or boat. Take a tour of the Frank Lloyd Wright Home and Studio or relax on a rubber-wheeled "San Francisco-style" trolley that stops at a number of popular spots around the city, including Navy Pier, the Grant Park museums, the

historic Water Tower, and the Sears Tower, Chinatown, Little Italy, and Harpo Studios.

As the **SVC Companions hostess, Jodie McClure** looks forward to helping our companion guests find their way around Chicago and organizing some fun activities to do together.

The daily itinerary will be flexible, and Jodie will be contacting companions to discuss individual interests and suggestions. A breakfast area will be reserved for companions at the Hyatt to meet Monday, Tuesday and Wednesday. Activities might include a few hours at the Art Institute of Chicago, lunch at one of the many fine restaurants, and a 90-minute sailing cruise on Windy, a 148-foot four-masted schooner from the Navy Pier. The schedule is always flexible and you don't have to join the group every day. If you want to learn more about Chicago before your arrival in April, visit www.meetinchicago.com and explore Chicago!

If you have any questions, please contact Jodie McClure, SVC Companions hostess, at jodiemcclure@hotmail.com or 715/689-2902.

"Make no little plans. They have no magic to stir men's blood..."

—Daniel H. Burnham, leader and visionary for the city of Chicago

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Making Life Easier for International Attendees and Exhibitors

Reference Web Sites:

U.S. DEPT. OF STATE, TRAVEL INFORMATION
For foreign citizens traveling to the United States and American citizens traveling abroad.
www.travel.state.gov

U.S. DEPT. OF STATE, VISA INFORMATION
Do you need a visa?

Visit this Web Site if you need a visa.

<http://travel.state.gov/visa/index.html>

O'HARE AIRPORT INTERNATIONAL SECURITY PROCESS

International travelers entering Chicago at O'Hare International Airport need to be aware of several important changes.

- *U.S. VISIT fingerprint collection pilot program.* Visit their Web Site at www.dhs.gov/us-visit for more information.
- *Passport requirements have changed.* Any passport issued on or after October 26, 2006, by a Visa Waiver Program (VWP) country, must be an e-Passport for VWP travelers to be eligible to enter the U.S. without a visa. The most common way of visiting the U.S. without a visa is through the VWP. Visit http://travel.state.gov/visa/temp/without/without_1990.html for more information.

Visa applications now require face-to-face interviews at the embassy or consulate in your country, digital fingerprints, and more involved personal data as part of the process. These are new rules and time consuming. The SVC Administrative Office will help you to attend our conference. As soon as you submit your abstract, send your request for the Letter of Invitation immediately to SVC at svcinfo@svc.org. You will need this Letter of Invitation to accompany your application for a visa, which you must take with you to the interview with the embassy in your country. The whole process can take at least four months depending upon your country of residence. SVC is here to assist you if you start the process early.

SVC has an International Freight Forwarder to assist exhibitors to get their equipment into the United States.

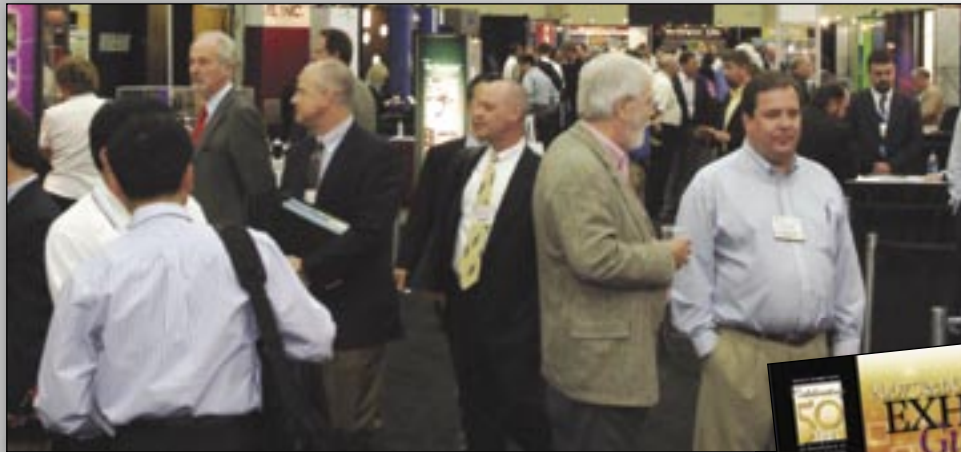
2008 Exhibit



This is the Only Exhibit Devoted Entirely to Vacuum Coating

Take Advantage of the Marketing Opportunities at our 51st Annual Show!

Exhibit Hours:
Monday, April 21
12:30 p.m.–7:00 p.m.
and Tuesday, April 22
10:00 a.m.–5:00 p.m.



TechCon Exhibit Guide

(Print and Digital Versions)

The *TechCon Exhibit Guide (TEG)* showcases the products and services of exhibiting companies participating in the annual SVC TechCon Exhibit. It highlights the upcoming presentations by the Plenary Speaker, Keynote Speaker, Donald M. Mattox Tutorial Speakers, and other invited speakers in the Technical Program, and also describes the Education

Program that is designed to assist registrants in solving their vacuum coating problems.

This is a unique opportunity for exhibitors to promote their presence at the TechCon Exhibit. The advance, first class mailing of the *Guide* will go to thousands of potential visitors working near the TechCon location.

The digital version of the TEG is sent to all SVC subscribers on a worldwide basis. Advertising in this *Guide* is an excellent

opportunity for your company to emphasize the services it offers to the vacuum coating community.

Closing date for artwork is February 1.



SVC Listens to our Exhibitors!

A flexible Technical Conference Program schedule provides long breaks for TechCon attendees to visit the Exhibit.

SVC attracts attendees to the Exhibit Halls and keeps them there!

- *Poster Session on Monday afternoon*
- *Networking Reception on Monday Evening (for everyone – including Exhibit visitors)*
- *Exhibitor Luncheon on Monday and Tuesday for TechCon registrants and Exhibit booth personnel*
- *Free Wireless Internet throughout the Exhibit Hall!*
- *Beer Blast for everyone*

We're also offering exhibitors an opportunity to take "live" hardware and products to the Exhibit in an effort to inform and educate our conference attendees. The "live" demonstrations will be offered on a rotating schedule over the two-day Exhibit.

Don't miss this opportunity to enhance your company's visibility at the TechCon. For more information on the **Innovators Showcase, Live Demonstrations, or to reserve your booth in this one-of-a-kind event**, visit the SVC Web Site at www.svc.org or call 505/856-7188.

Deadline for submitting abstracts for the Innovators Showcase is March 1, 2008 to be included in the Final Program.

Target Marketing

The SVC TechCon and Exhibit is a wise investment of your conference and marketing dollars. We offer many opportunities to promote your products and services during this annual event and throughout the year.

New in the Exhibit Hall in Chicago! Live Demonstrations and Innovators Showcase

This year, the popular Innovators Showcase session will be presented in the Exhibit Hall and will be scheduled to coincide with show hours. This unique promotional venue will mean that attendees touring the exhibit hall can "drop in" for one or more of the 10-minute presentations about new products, new equipment, or a new process.



Sponsor one or more of these Tech-Con Events

Choices include the *Wireless Internet in the Exhibit Hall, Beer Blast*, and the *SVC Night at the Chicago House of Blues*. All sponsors are widely acknowledged in SVC publications, including the Final Program, the *Bulletin*, Web Site, and on signage at the TechCon.

Target Advertising Opportunities in SVC Publications and on Our Web Site!

Bulletin (Print and Digital Versions)

The *SVC Bulletin* informs and educates with its balanced mix of news and technology. The *Bulletin* is published three times each year (spring, summer, and fall), and is read by more than 15,000 professionals working in the vacuum coating community and related sciences and technologies. Each issue contains previews or reviews of the TechCon, SVC committee activities, technical articles, book reviews, Corporate Sponsor news and profiles, and Society news.

The *Bulletin* will continue to expand its editorial content, with each issue featuring several original contributed articles and reprints of some of the most interesting papers presented at the most recent TechCon. This expansion offers advertisers more four-color advertising opportunities. When space is limited, priority will be given to four color ads.

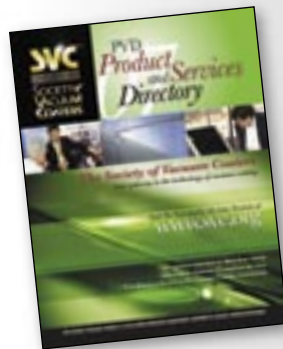
Your ad in the *Bulletin* also gets viewed by an international list of subscribers to our digital version of the *Bulletin*. This enhanced version offers viewers direct hyperlinks to advertisers, easy navigation and searchable content.

Closing date for artwork is February 1.



Take Advantage of 24/7 Web Site Advertising

Purchase a logo and [Visit Us!](#) hyperlink on the SVC Web Site, and experience the many benefits of Web advertising long after the TechCon. The Virtual Exhibit section of the Web Site remains live until almost the end of the calendar year, when the 2009 Exhibitors are uploaded and the cycle begins again.



Product & Services (P&S) Directory

SVC members facilitate their search for vacuum coating products and services by turning to the resources listed in the *PVD Product and Services Directory*. Updated annually, the *Directory* is mailed to SVC members and others who contact SVC looking for products and services related to the vacuum coating field. By offering free listings, SVC can provide a more complete directory to the vacuum coating community. Give your company greater emphasis with an ad in the *Directory*.

Closing date for artwork is August 1.

Exhibiting Companies at the 51st Annual TechCon (as of December 8, 2007)

A&N Corporation	ESI Group	MDC Vacuum Products, LLC.	Sigma Technologies International, Inc.
Academy Precision Materials	Evatec	Micro Photonics Inc.	Soleras Ltd.
Advanced Energy Industries, Inc.	Exotech, Inc.	Midwest Tungsten Service, Inc.	SOLVIX SA
Advanced Vacuum Co., Inc. (ADVACO)	Ferrotec (USA) Corporation	Mill Lane Engineering Co., Inc.	Sputtering Components, Inc.
Alcatel Vacuum Products, Inc.	Fil-Tech, Inc.	MKS Instruments, Inc.	Sumitomo (SHI) Cryogenics of America, Inc.
Alicat Scientific, Inc.	Filmetrics, Inc.	Morgan Advanced Ceramics - Diamonex Products	SVC Foundation
Ametek, Inc.	Fraunhofer FEP	MPT Industries	SVS Vacuum Coating Technologies
Angstrom Engineering, Inc.	Galileo Vacuum Systems, Inc.	Mustang Vacuum Systems	Sycon Instruments, Inc.
Angstrom Sciences, Inc.	General Plasma, Inc.	Niles Electronics, Inc.	Synergy Vacuum, Inc.
Angstrom Sun Technologies, Inc.	GENERAL Vacuum Equipment Ltd.	Nivo Technology	System Control Technologies (SCT) Telemark
Applied Materials	Gfe Materials Technology, Inc.	Nor-Cal Products, Inc.	Thermal Conductive Bonding, Inc.
Austin Scientific, an Oxford Instruments Company	GNB Corporation	Oerlikon Leybold Vacuum USA Inc.	Thermionics Vacuum Products
Bekaert Advanced Coatings N.V.	Hauzer Techno Coating BV	Osaka Vacuum U.S.A., Inc.	Thin Film Center, Inc.
Beneq	HeatWave Labs, Inc.	Pfeiffer Vacuum	Toho Technology
Brooks Automation, Inc.	Heraeus Incorporated	PHPK Technologies	Torr International, Inc.
Brooks Instrument	HORIBA Jobin Yvon, Inc.	Plansee GmbH	Tuthill Vacuum & Blower Systems
Burkert Fluid Control Systems	HUETTINGER Electronic, Inc.	Plasma Process Group, Inc.	UC Components, Inc.
CeramTec North America	Huntington Mechanical Laboratories, Inc.	Plasmaterials, Inc.	UCM-AG
Chengdu Ultra Pure Applied Materials Co., Ltd.	HVA, LLC.	Precision Metal Works Ltd.	Umicore Thin Film Products
Coastal Instruments, Inc.	INFICON	Process Materials, Inc.	Vacuum Engineering & Materials Co., Inc.
Coating Materials a Div of Tico Titanium, Co.	Inland Vacuum Industries	ProTech Materials	Vacuum Process Technology, Inc.
CSM Instruments, Inc.	IntVac	PTB Sales, Inc.	Vacuum Research Ltd.
Cyber Materials	IonBond	PVT Plasma und Vakuum Technik GmbH	Vacuum Technology & Coating Magazine
Dark Field Technologies, Inc.	J.A. Woollam Co., Inc.	R.D. Mathis Company	Vapor Technologies, Inc.
Darby Custom Technology, Inc.	Kashiyama USA, Inc.	REACTIVE NANOTECHNOLOGIES, INC.	Varian, Inc.
Denton Vacuum, LLC	KBM Corporation	Rigaku Innovative Technologies	VAT, Inc.
Dexter Magnetic Technologies, Inc.	KDF	Rocky Brook Associates, Inc.	Veeco Instruments, Inc.
Duniway Stockroom Corporation	Kolzer	SAGE industrial sales, inc.	Vergason Technology, Inc.
DynaVac	Kurt J. Lesker Company	SCI Engineered Materials	VON ARDENNE
EB Sources	LayTec GmbH	Semicore Equipment, Inc.	William Andrew
Edwards	Leybold Optics	Sidrabe, Inc.	Williams Advanced Materials
	M. Theiss Hard-and Software	Sierra Applied Sciences, Inc.	XEI Scientific, Inc.
	Materials Science, Inc.	Sigma Instruments, Inc.	
	Materials Science International, Inc.		



2008 TechCon Education Program

April 19–24, 2008

SVC Preliminary Course Roster

You do not have to register for the TechCon or be a member of SVC to attend courses.

Anyone can take advantage of the practical problem-solving courses developed by the SVC. Taught by some of the most respected professionals in the vacuum coating industry, these courses cover every aspect of vacuum coating. Thirty courses will be offered, including three new courses on Hot Topics! Courses complement the technical conference sessions and Exhibit. Discounted fees are available for students. For more detailed information, visit the education section of the SVC Web Site at www.svc.org. Register on-line or contact the SVC at 505/856-7188 or E-mail to svcinfo@svc.org.

EDUCATION PROGRAM SCHEDULE

	April 19 Saturday	April 20 Sunday	April 21 Monday	April 22 Tuesday	April 23 Wednesday	April 24 Thursday
Vacuum Technology: Components and System <i>(Discount package for V-201, V-202, and V-203 available)</i>						
High Vacuum System Operation (O'Hanlon)	V-201					
An Introduction to Physical Vapor Deposition (PVD) Processes (Shah)	C-103					
Basics of Vacuum Web Coating (McClure)	C-204					
Thin Film Growth and Microstructure Evolution (Greene)	C-311					
Sputter Deposition (Greene) - 2-Day Course		C-203	C-203			
Vacuum System Gas Analysis (O'Hanlon)		V-202				
Optical Coating Design and Monitoring (Willey)		C-301				
Plasma Modification of Polymer Materials and Plasma Web Treatment (Grace)		C-314				
High Power Impulse Magnetron Sputtering (Anders/Ehiasarian) NEW!		C-323				
Characterization of Thin Films (Christensen) NEW!		C-322				
Vacuum Materials and Large System Performance (O'Hanlon)			V-203			
Practical Aspects of Optical Coatings (Morton)			C-302			
Primer on Thin Films and Vacuum Technology (McCrary)			C-101			
Introduction to Plasma Processing Technology (Barankova & Bardos) Half-day p.m.			C-210 (p.m.)			
Sputter Deposition in Manufacturing (Glocker)				C-208		
Reactive Sputter Deposition (Greene)				C-315		
Sputter Deposition onto Flexible Substrates (McClure)				C-211		
Tribological Coatings (Sproul & Matthews)				C-308		
Introduction to Ellipsometry (Hilfiker)				M-102		
Troubleshooting for Thin Film Deposition Processes (Ash)					C-212	
The Practice of Reactive Sputtering (Sproul)					C-317	
Nucleation & Growth of Nanostructures (Greene)					C-318	
ITO and Other Transparent Conductive Coatings: Fundamentals, Deposition, Properties, and Applications (Bright)					C-304	
Practical Aspects of Vacuum Technology: Operation & Maintenance of Production Vacuum Systems (Langley)					V-207	
Nonconventional Plasma Sources and Methods in Processing Technology (Barankova & Bardos)						C-306
Introduction to Energy Conversion Materials and Technology (Martin)						C-319
Evaporation as a Deposition Process (Belkind)						C-207
Alternative Transparent Conductive Coatings (TCOs) to ITO (Bright) Half-day a.m. NEW!						C-321 (a.m.)
Diamond Like Carbon Coatings – from Basics to Industrial Realization (Schuelke, Bewilogua & van der Kolk) Half-day a.m.						C-320 (a.m.)

Course Classification System

The course codes are intended to provide the prospective attendee with some guidance as to whether the emphasis in the course is primarily on vacuum technology (V code), or vacuum deposition coating processes and technology (C code), or other miscellaneous topics (M code). The course number is intended to indicate the level of course specialization—the lower numbers refer to courses that are basic or introductory in nature, and the higher numbers refer to courses that offer a more specialized treatment of a specific topic. Courses are full day (8:30 a.m. to 4:30 p.m.) unless otherwise noted.

Short Courses

Offered at the TechCon



EDUCATION PROGRAM SCHEDULE

>> Saturday, April 19

Vacuum Technology: Components and Systems (V-201, V-202, V-203 offered April 19, 20 and 21)

This group of courses (V-201, V-202, and V-203) is designed in modular form where each module consists of a lecture, a problem-solving or demonstration session, and a review. All participants are expected to bring a pocket calculator and take part in group problem solving. The courses are not theoretical, but practical. They emphasize the underlying concepts in a physical rather than a mathematical way. Prerequisites are a desire to learn, and enough of a mathematics background to handle simple algebra. Persons registering for three of this specific group of courses at the SVC Technical Conference receive a discounted fee of \$1,350 and only one textbook is provided in this case. The Student fee for all three courses is \$425.

V-201 | High Vacuum System Operation

Saturday, April 19 8:30 a.m.–4:30 p.m.
Course fee: \$625 (includes textbook) Student fee: \$190

This course is intended for those who wish to learn how mechanical pumps and high vacuum pumps form a high vacuum system and how three such systems are operated. At the end of this course, using all available materials, a participant should be able to explain the operation of diffusion, cryo, and turbo pumped systems; understand the differences between a viscous gas and a rarefied gas; and show how these differences govern the operation of the systems.

Course Content

- Introduction to vacuum systems
- Rotary mechanical pumps
- Diffusion pumps and systems
- Cryogenic pumps and systems
- Turbomolecular pumps and systems

Attendees in this course receive the text, *A User's Guide to Vacuum Technology*, 3rd edition, John O'Hanlon (John Wiley & Sons, 2003).

Instructor: John O'Hanlon, *University of Arizona*

John F. O'Hanlon is Professor Emeritus of Electrical and Computer Engineering, the University of Arizona. He retired from IBM Research Division in 1987, where he was involved in thin-film deposition, vacuum processing, and display technology. He retired from UA in 2002, where he directed the NSF Ind./Univ. Center for Microcontamination Control. His research focused on particles in plasmas, cleanrooms, and ultrapure water contamination. He is the author of *A User's Guide to Vacuum Technology*, 3rd edition. (John Wiley & Sons, 2003).

Also available through the **On-Site Education** Program

C-103 | An Introduction to Physical Vapor Deposition (PVD) Processes

Saturday, April 19 8:30a.m.—4:30 p.m.
Course fee: \$625 (includes textbook) Student fee: \$190

Physical vapor deposition (PVD) processes are atomistic deposition processes in which material vaporized from a source is transported in the

form of a vapor through a vacuum or low-pressure gaseous environment to the substrate, where it condenses and film growth takes place. PVD processes can be used to deposit films of compound materials by the reaction of depositing material with the ambient gas environment or with a codeposited material. This course will discuss and compare the four basic PVD techniques: vacuum evaporation, sputter deposition, arc vapor deposition, and ion plating. Vacuum evaporation uses thermal vaporization as a source of depositing atoms; sputter deposition uses physical sputtering as the vaporizing source; arc vapor deposition uses a high-current, low-voltage arc for vaporization; and ion plating uses concurrent or periodic energetic particle bombardment to modify the film growth. The parameters used for each technique will be discussed along with their advantages, disadvantages, and applications. This is an entry-level course to acquaint the students with various PVD processes used for "surface engineering."

Course Content

- Introduction: deposition environments (vacuum and plasma), film formation, film structures, reactive deposition, factors affecting film properties
- Vacuum evaporation and vaporization, evaporation and sublimation, deposition chambers, vaporization sources (resistive and e-beam), evaporation materials, fixture design, process parameters, monitoring and control, advantages and disadvantages, applications
- Sputter deposition and physical sputtering, plasmas (dc, rf, magnetron, and pulsed dc), sputtering target configurations, reactive sputter deposition, sputtering materials, process parameters, monitoring and control, advantages and disadvantages, applications
- Arc vapor deposition and vacuum and plasma arcs, properties of arcs, generation and "steering" of arcs, arc sources, reactive arc deposition, process parameters, monitoring and control, advantages and disadvantages, applications
- Ion plating and bombardment effects, bombardment configurations, reactive ion plating, ion plating vaporization sources and evaporation, sputtering and arc process parameters, monitoring and control, advantages and disadvantages, applications
- PVD deposition systems and configurations (batch, load-lock, and in-line), pumping options

The course fee includes the text, *Handbook of Physical Vapor Deposition (PVD) Processing*, Donald M. Mattox (William Andrew Publishing/Noyes Publications, 1998).

Instructor: S. Ismat Shah, *University of Delaware*

S. Ismat Shah graduated from the University of Illinois at Urbana-Champaign in 1986 from the Department of Materials Science and Engineering. He worked for the DuPont Company as senior Staff Scientist for 12 years before joining the University of Delaware in 1999 where he has a joint appointment in the Department of Materials Science and Engineering and the

To view a Detailed Course Syllabus for each course, go to the SVC Web Site at www.svc.org and click on the Education Program button to locate the course of interest. For details concerning the SVC On-Site Education Program, please contact SVC at svcinfo@svc.org.

Department of Physics and Astronomy. He has been involved in the field of thin films and nanostructured materials for 22 years. He has over 120 publications in the field and 5 patents awarded. He is the Chair of the SVC Education Committee. He teaches the first on-line course offered by the SVC, in collaboration with the University of Delaware, on Vapor Deposition Processes.

Also available through the **On-Site Education Program**

C-204 | Basics of Vacuum Web Coating

Saturday, April 19

8:30a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

This course is intended for roll coater machine operators, maintenance personnel, technicians, engineers, scientists, supervisors, and others who would benefit from an introduction to issues related to roll-to-roll vacuum coating onto polymer substrates. This course will emphasize practical aspects of the topics, and the treatment will be descriptive with little mathematics used. The course focuses strongly on coatings made by resistance evaporation but touches on e-beam and induction evaporation and sputter coating. If your primary interest is sputtering onto webs, please see our other offering, "Sputter Deposition onto Flexible Substrates" (C-211).

Course Content

This course provides the participant with an introduction to:

- Markets for coated web products
- Vacuum technology for web coating
- Substrate characteristics
- Web handling and web winding systems
- Coating techniques and web cooling issues
- Process and product monitoring methods
- System maintenance issues
- Sources of information about web coating

Instructor: Donald J. McClure, *Acuity Consulting and Training*

Donald J. McClure is President of Acuity Consulting and Training and recently retired from 3M's Corporate Research Laboratory, where he spent twenty five years working on a broad range of products and projects that utilized vacuum roll coating and processing. Don served the Society of Vacuum Coaters in many roles including President and Secretary. He has offered his courses on the "Basics of Vacuum Web Coating" and "Sputter Deposition onto Flexible Substrates" for many years. His presentation, "A Wizard's Guide to Vacuum and Vacuum Coating," has received rave reviews from attendees. He was the SVC's 2004 Nathaniel Sugerman Award recipient.

Also available through the **On-Site Education Program**

C-311 | Thin Film Growth and Microstructure Evolution

Saturday, April 19

8:30a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

This course is intended for engineers, technicians, and others involved with the vapor deposition of thin films by sputtering, evaporation, MBE, CVD, GS-MBE, etc., and who need to obtain a better understanding of the effects of operating parameters on the properties of metal, semiconductor, and dielectric films and alloys. The course is concentrated on the development of a detailed atomic-scale understanding of the primary experimental variables and surface reaction paths controlling nucleation/growth kinetics and microstructural evolution during vapor-phase deposition of thin films. The goal is to develop an appreciation of the advantages and disadvantages of competing growth techniques and to learn how to design better and more efficient film growth processes to achieve required properties.

Thin-film technology is pervasive in many advanced fields of modern technology including microelectronics, optics, magnetics, hard and corrosion-resistant coatings, micromechanics, etc. Progress in each of these areas depends upon the ability to selectively and controllably deposit thin films (thickness ranging from tens of Ångströms to micrometers) with specified physical properties. This, in turn, requires control—often at the atomic level—of film microstructure and microchemistry.

Essential fundamental aspects, as well as the technology of thin-film

nucleation and growth from the vapor phase (evaporation, MBE, sputtering, and CVD) are discussed in detail and highlighted with "real" examples. The course begins with an introduction on substrate surfaces: structure, reconstruction, and adsorption/desorption kinetics. Nucleation processes are treated in detail using insights obtained from both in situ (RHEED, LEED, STM, AES, EELS, etc.) and post-deposition (TEM and AFM) analyses. The primary modes of nucleation include two-dimensional (step flow, layer-by-layer, and two-dimensional multilayer), three-dimensional, and Stranski-Krastanov. The fundamental limits of epitaxy will be discussed.

Experimental results and simulations will be used to illustrate processes controlling three-dimensional nucleation kinetics, island coalescence, clustering, secondary nucleation, column formation, preferred orientation, and microstructure evolution. The effects of low-energy ion-irradiation during deposition, as used in sputtering and plasma-CVD, will be discussed with examples.

Course Content

The course provides an understanding of:

- The role of the substrate in mediating growth kinetics
- The nucleation process
- Film growth modes
- Epitaxy
- The development and control of film stress (strain engineering)
- Nucleation and growth of strain-mediated self-organized structures
- Polycrystalline film growth, texture, and microstructure evolution
- Structure-zone models of film microstructure
- The role of low-energy ion/surface interactions during film growth
- The relationship between film growth parameters and film properties

Instructor: Joe Greene, *D.B. Willett Professor of Materials Science and Physics, University of Illinois, and Past Director of the Frederick Seitz Materials Research Laboratory.*

Joe Greene is the D.B. Willett Professor of Materials Science and Past Director of the Frederick Seitz Materials Research Laboratory at the University of Illinois. The focus of his research has been the development of an atomic-level understanding of adatom/surface interactions during vapor-phase film growth in order to controllably manipulate microchemistry, microstructure, and physical properties. His work has involved film growth by all forms of sputter deposition (MBE, CVD, MOCVD, and ALE). He was President of the American Vacuum Society in 1989, a consultant for several research and development laboratories, and a visiting professor at several universities. Recent awards include receipt of the Aristotle Award from SRC (1998), the Adler Award from the American Physical Society (1998), Fellow of the American Vacuum Society (1993) and the American Physical Society (1998), and the Turnbull Prize from the Materials Research Society (1999). He was elected to the US National Academy of Engineering in 2003. He is the Editor in Chief of *Thin Solid Films*.

Also available through the **On-Site Education Program**

>> Sunday, April 20

V-202 | Vacuum System Gas Analysis

Sunday, April 20

8:30 a.m.—4:30 p.m.

Course fee: \$625

(includes textbook)

Student fee: \$190

This course is intended for those who wish to understand how to analyze the performance of a vacuum system. Basic vacuum gauges that measure pressure in the low vacuum and in the high vacuum region will be described. Residual gas analyzers provide a useful method of analyzing the performance of a system and how various components are operating by looking at the partial pressures of individual gases. The class concludes with a discussion of leak detection: when it should be attempted and how to detect leaks with a pressure gauge, an RGA, and a mass spectrometer leak detector.

Course Content

- Gas laws
- Gas flow
- Vacuum gauges
- Residual gas analyzers
- Leak detection

Attendees in this course receive the text, *A User's Guide to Vacuum Technology*, 3rd edition, John O'Hanlon (John Wiley & Sons, 2003).

Instructor: John O'Hanlon, *University of Arizona*

For John O'Hanlon's profile, see V-201 (Saturday).

Also available through the **On-Site Education Program**

C-203 | Sputter Deposition (two-day course)

Sunday and Monday, April 20–21

8:30a.m.—4:30 p.m.

Course fee: \$830

Student fee: \$190

This course covers fundamental mechanisms associated with generation of glow discharges, sputtering, and energetics of target and substrate processes. Operation and system design will be discussed for dc, rf, magnetron (both magnetically balanced and unbalanced), pulsed dc, and ion beam sputtering. The advantages and disadvantages of these different modes of operation will be examined from the point of view of controlling film properties. Emphasis is placed on developing a sufficient understanding of sputter deposition to provide direction in designing new processes. Present and future trends in sputter deposition also will be addressed.

Course Content

- Processes controlling film growth and properties
- The role of energetic particles in controllably modifying these processes
- Target sputtering effects
- Nature and energy of sputtered atoms
- Diode, triode, magnetron, and ion beam systems
- dc, pulsed dc, mid-frequency ac, and rf power for targets and substrates
- Reactive sputtering of conducting and dielectric layers
- Alloy sputtering

Instructor: Joe Greene, *D.B. Willett Professor of Materials Science and Physics, University of Illinois, and Past Director of the Frederick Seitz Materials Research Laboratory.*

For Joe Greene's profile, see C-311 (Saturday).

Also available through the **On-Site Education Program**

C-301 | Optical Coating Design and Monitoring

Sunday, April 20

8:30a.m.—4:30 p.m.

Course fee: \$595

(includes textbook)

Student fee: \$190

This course covers optical coating design principles and techniques from both classical approaches and other different viewpoints. Methods for the design and execution of monitoring strategies to produce desired coating results are described. The sensitivities, possibilities, and limitations of most control techniques are described.

Course Content

- Fundamentals of thin film optics from various points of view
- The use of graphical methods for understanding and designing optical coatings
- A Fourier viewpoint of optical coatings
- Practical monitoring and control of thin film growth
- Error compensation and degree of control
- Sensitivity to errors and monitoring strategies

The course fee includes two textbooks: *Practical Design of Optical Thin Films*, Ronald R. Willey, 2007; and *Practical Monitoring and Control of Optical Thin Films*, Ronald R. Willey, 2007 (both published by Willey Optical Consultants).

Instructor: Ronald R. Willey, *Willey Optical, Consultants*

Ronald R. Willey graduated from the MIT in optical instrumentation, has an M.S. from FIT, and over 35 years of experience in optical system and coating development and production. He is very experienced in practical thin films design, process development, and the application of industrial Design Of Experiments methodology. He is the inventor of a robust plasma/ion source for optical coating applications. He worked in optical instrument development and production at Perkin-Elmer and Block Associates. He developed automatic lens design programs at

United Aircraft Research Laboratories. He formed Willey Corporation in 1964 and served a wide variety of clients with consulting, development, prototypes, and production. In 1981 he joined Martin Marietta Aerospace and was Director of the Optical Component Center where he was responsible for optical fabrication, coating, and assembly. He joined Opto Mechanik in 1985 where he was responsible for the development of all new technologies, new instruments, and production engineering. He was a Staff Scientist at Hughes Danbury Optical Systems. He holds four patents and has published many papers and a book on optical coating, optical design, and economics of optical tolerances. He is a fellow of the Optical Society of America and SPIE and a past Director of the Society of Vacuum Coaters. He now is a consultant in the above-listed technical areas.

Also available through the **On-Site Education Program**

C-314 | Plasma Modification of Polymer Materials and Plasma Web Treatment

Sunday, April 20

8:30a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

Plasma treatments are used in the web coating and roll conversion industries to tailor polymer surfaces while preserving their bulk properties. This course is intended for engineers, scientists, and technicians who would like to gain a better understanding of the influence of plasma process factors on treatment performance, as well as the practical issues related to process robustness, process speed, and ease of scale-up. While much of the course deals with treatment of polymer webs, the key concepts presented are applicable to polymer surfaces in general and plasma treatment of materials in general.

The course will include:

- A basic introduction to plasmas including discussion of species distributions, the structure of glow-discharge plasmas, electrical breakdown of gases, and mechanisms of sustaining a plasma.
- Discussion of industrial applications of plasmas for polymer surface modification including wettability control & printing, bonding & adhesion, nucleation of films, control of biointeraction with surfaces, and control of gas-film interactions.
- Description of a variety of plasma treatment technologies and the importance of controlling the industrial treatment environment.
- The interaction of plasmas with polymer surfaces.
- The basics of polymer surface analysis along with examples of surface analytical techniques applied to plasma treated polymers including X-ray photoelectron spectroscopy, static secondary ion mass spectrometry, and high-resolution electron energy loss spectroscopy. Also included is discussion of adhesion, wettability, etc.
- Practical aspects of plasma web treatment including treatment dose, process factors and their roles, practical treatment efficiency, process verification, and process stability issues.
- Mechanisms of surface modification in the context of a site balance model.

Instructor: Jeremy M. Grace, *Eastman Kodak*

Jeremy M. Grace is currently a senior principal scientist at the Eastman Kodak company. At Kodak, he has worked in the areas of plasma surface modification, thin-film adhesion, sputter deposition, and organic vapor deposition. He has received several patents and journal articles in the area of plasma modification of polymers. He is a member of the American Vacuum Society and served as chair of the Upstate New York Chapter (UNY-VAC) from 1998 - 2000.

Also available through the **On-Site Education Program**

New!

C-322 | Characterization of Thin Films

Sunday, April 20

8:30a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

This course examines the broad range of techniques available to characterize thin film materials. We examine the range of properties of interest and how thin film properties may differ from bulk properties. Generic differences between counting and spectroscopic techniques are presented. Available "probes" are identified.

The main emphasis of the course is an overview of a wide range of characterization techniques. We examine imaging techniques such as Optical

microscopy, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), and Scanning probe microscopies (STM, AFM ...). We also explore techniques, which provide information about structural properties including X-ray diffraction (XRD), Stylus profilometry, Quartz crystal monitors (QCM) and density measurements.

The course examines techniques, which explore chemical properties such as Auger electron spectroscopy (AES), Energy Dispersive Analysis of X-rays (EDAX), X-ray Photoelectron Spectroscopy (XPS, ESCA), Secondary Ion Mass Spectrometry (SIMS), and Rutherford Backscattering (RBS). AES is used as a prototype to examine quantitative analysis of spectroscopic data. Characterization techniques for optical properties such as ellipsometry and optical scattering are also considered. Many of these chemical and optical techniques can also provide information about structural properties.

Techniques for determining electrical and magnetic properties are also discussed. These include resistance / four point probe, Hall effect, magneto-optical Kerr effect and ferromagnetic resonance. The emphasis here is on materials characterization as opposed to device characterization.

The course concludes with an examination of techniques used to explore mechanical properties such as stress-curvature measurements, friction testing, micro/nano indentation and adhesion tests.

Course Content

Overview of wide range of characterization techniques for thin films including:

- Mechanical properties (stress, friction, micro/nano indentation, adhesion...)
- Imaging (microscopies: optical, SEM, TEM, AFM ...)
- Structural properties (XRD, profilometry, QCM ...)
- Chemical properties (AES, EDAX, XPS, SIMS, ...)
- Electrical/magnetic properties (resistance, Hall effect, Kerr effect ...)

Instructor: Tom Christensen, *University of Colorado at Colorado Springs*

Tom Christensen is a Professor in the Department of Physics at the University of Colorado at Colorado Springs. He received his B.S. in physics from the University of Minnesota in 1979 and his M.S. and Ph.D. degrees in Applied Physics from Cornell University. After several years as a member of the technical staff at Sandia National Laboratories in Albuquerque he joined the University of Colorado faculty in 1989. He has worked with vacuum technology, thin film technology and surface characterization since 1980 and has taught local AVS short courses since 1992.

New!

C-323 | High Power Impulse Magnetron Sputtering

Sunday, April 20
Course fee: \$520

8:30a.m.—4:30 p.m.
Student fee: \$95

This course is intended for engineers, technicians, students, and others interested in high power impulse magnetron sputtering (HIPIMS). With HIPIMS we mean a pulsed sputtering process where the power density on the sputtering target is greatly enhanced (about two orders of magnitude) over the average power density. Hence, the word "impulse" is adopted to signify a low duty cycle of operation.

Some basic understanding or experience with plasmas and materials is desirable but not required. The course starts with a brief introduction to basic plasma and sheath physics. The operation of dc magnetrons is explained to provide the foundation for the understanding of the time-dependent processes in pulsed systems, and especially those of HIPIMS discharges.

High power density leads to significant ionization of the sputtered material, enabling effective surface modification via ion etching and ion assistance to film growth. The interface to the substrate can be engineered and the film texture can be influenced using the HIPIMS plasma in combination with an appropriate bias.

Course Content

- HIPIMS - An Introduction
- Stationary plasmas, sheaths, discharge
- The dc magnetron processes
- Ion surface modification: etching and film growth, energetic condensation
- Pulsed plasmas and sheaths
- High Power Impulse Magnetron Sputtering: the discharge
- Plasma characterization and plasma diagnostics
- Substrate biasing: etching / growth assist
- Interface engineering by using HIPIMS plasmas
- Deposition and coatings by HIPIMS
- Hardware
- Applications

Instructors: André Anders, *Lawrence Berkeley National Laboratory* and Arutiun Ehasarian, *Sheffield Hallam University, United Kingdom*

André Anders is the Leader of the Plasma Applications Group at Lawrence Berkeley National Laboratory, Berkeley, California. He studied physics in Poland, Germany, and Russia. He holds an M.S. (1984) and Ph.D. degree (1987) in physics from Humboldt University, Berlin. He was with the Academy of Sciences, Berlin, 1987-1991, and moved to Berkeley, CA, in 1992. His research includes coatings by sputtering and cathodic arcs, plasma immersion ion implantation, and plasma and ion source development. He has authored about 160 papers in refereed journals and holds several patents. He is the author of *A Formulary for Plasma Physics* (Akademie, Berlin, 1990), the editor and co-author of the *Handbook of Plasma Immersion Ion Implantation and Deposition* (Wiley, NY, 2000); and *Cathodic Arc Plasma Deposition*, (about to be published by Springer, NY). He serves on several international advisory committees of conferences and on the Editorial Board of Surf. & Coat. Technol. He is a Fellow of IEEE and IoP (UK), and a member of MRS, AVS, and SVC. He received the Chatterton Award (1994) and an R&D 100 Award (1997).

Arutiun Ehasarian joined the Nanotechnology Centre for PVD Research at Sheffield Hallam University, UK in 1998 where he obtained his PhD in Plasma Science and Surface Engineering. His research within NTC-PVD has concentrated on development of plasma PVD technologies for substrate pretreatment prior to coating deposition to improve adhesion, deposition of coatings with dense microstructure, low-pressure plasma nitriding and hybrid processes of plasma nitriding/coating deposition. He has experience with cathodic vacuum arc discharges, dc and pulsed magnetron discharges, and radio-frequency coil enhanced magnetron sputtering. He utilises plasma diagnostics such as optical emission spectroscopy (OES), electrostatic probes, energy-resolved mass spectroscopy and atomic absorption spectroscopy. Materials characterisation includes high-resolution TEM, STEM, STEM-EDS, SEM, and XRD as well as mechanical testing available at NTC-PVD. He is one of the pioneers of high power impulse magnetron sputtering (HIPIMS) technology and his work in the field has been acknowledged with the R.F. Bunshah Award (2002) and the TecVac Prize (2002). He is an author of more than 30 publications, 10 invited lectures and 3 patents in the field of PVD and HIPIMS.

>> Monday, April 21

V-203 | Vacuum Materials and Large System Performance

Monday, April 21

Course fee: \$625

(includes textbook)

8:30 a.m.—4:30 p.m.

Student fee: \$190

This course is intended for those who wish to learn the basics of vacuum materials and large system performance. Materials used for sealing and constructing high vacuum systems, as well as fluids for pumping and lubricating will be reviewed. The performance of large systems used for coating rigid and flexible substrates forms the backbone of work done by members of the SVC. Here we will describe the performance of systems used for coating rigid substrates (batch coaters) and flexible substrates (roll coaters). We will characterize when, why, and how to cross-over properly from roughing pumping to high vacuum pumping for all types high vacuum system types. We will illustrate the effects of outgassing, permeation and gas loading on system operation.

Course Content

- Materials in vacuum
- Seals, joints, and valves
- Rough pumping large systems
- System performance
- Multichamber systems

Attendees in this course receive the text, *A User's Guide to Vacuum Technology*, 3rd edition, John O'Hanlon (John Wiley & Sons, 2003).

Instructor: John O'Hanlon, *University of Arizona, Tucson*

For John O'Hanlon's profile, see V-201 (Saturday).

Also available through the **On-Site Education Program**

C-302 | Practical Aspects of Optical Coatings

Monday, April 21

8:30a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

This course covers methods for depositing optical thin film materials and the parameters to control to achieve desired properties. Various deposition source types will be presented with strong emphasis on physical vapor deposition (sputtering and evaporation). Both qualitative and quantitative methods for characterizing thin films will be presented.

Course Content

- Methods for depositing thin films and for calculating performance
- Measuring optical thin films and calculating optical properties (n and k)
- Dispersion models for optical thin films
- Comparison of characterization techniques
- Effect of deposition parameters on optical properties
- Ion-assisted deposition
- Thin film material properties for dielectric and metal films
- Review of optical properties for other selected materials

Instructor: Dale E. Morton, *Denton Vacuum, LLC (retired)*

Dale E. Morton has retired as the Process R&D Manager of the High Vacuum Equipment Division of Denton Vacuum, LLC. He also was Product Manager for the cold cathode ion source product line. He has 35 years of experience in design and process development for optical thin film applications with a strong emphasis on the characterization of the optical properties of thin film materials. He is a past director of the SVC (1994 to 2000) and is a former Optical Coating TAC Chair (1993 to 1995) and Program Chair (1997 to 1999) for the SVC Annual Technical Conference.

Also available through the **On-Site Education Program**

Nathaniel Sugerman Memorial Course

C-101 | A Primer on Thin Films and Vacuum Technology

Monday, April 21

8:30a.m.—4:30 p.m.

Course fee: \$260

Student fee: \$45

Nathaniel Sugerman was a founding member, an avid supporter, and mentor of the Society of Vacuum Coaters. This course was created in his memory for newcomers to the vacuum coating industry and for those nontechnical people associated with the industry who wish to gain a basic knowledge of thin film and vacuum technology. The course is intended for people who are complete novices in the field.

This course will provide an overview of vacuum and thin film technology associated with the manufacture of a variety of consumer products. These products are compact discs, food packaging barrier coatings (e.g., potato chip bags), sunglasses and ophthalmic coatings, optical coatings, and integrated circuits.

The deposition techniques used to manufacture the above-listed products will be described at the introductory level, including sputtering, evaporation, and chemical vapor deposition. In addition, a survey of various methods to clean and prepare substrates will be discussed. The nature of what a vacuum is, how it is achieved, and the techniques required to maintain the necessary vacuum for the above deposition processes will be described in some detail. Vacuum measurement techniques and residual gas analysis will be given a brief overview. Students will be given a private preview of typical key exhibits prior to the opening of the Exhibit Hall.

Course Content

- Some commercial products using vacuum technology
- What is a vacuum?
- How is a vacuum achieved?

- What is a thin film?
- How is a thin film produced?
- Uses for thin films

The course fee includes the *SVC Education Guides to Vacuum Coating Processing*.

Instructor: Leon McCrary, *Denton Vacuum, LLC (retired)*

Leon McCrary is retired as the Marketing Manager at Denton Vacuum, LLC. He has over 40 years of experience in vacuum technology and coating development. He holds a patent for the "Ivadizer" process (ion plating of aluminum for corrosion protection onto steel and aluminum alloys) and for a broad beam ion source used for ion-assisted deposition. His current specialty is in optical coaters used primarily for precision optics and telecommunications. He has specialized in the reactive sputtering of oxide coatings on a large scale and the development of applying new coating technology to production equipment. He was on the Board of Directors of the SVC for a number of years and was the Treasurer of the Society for six years.

Also available through the **On-Site Education Program**

C-210 | Introduction to Plasma Processing Technology (half-day)

Monday, April 21

1:00 p.m.—4:30 p.m.

Course fee: \$365

Student fee: \$70

The goal of the course is to show the link and provide understanding of relations between coating application, coating (or modified surface) properties, selection criteria on process characteristics, selection criteria on plasma parameters, and method design. It is possible to predict how the process parameters will be reflected in the coating and in the opposite direction, requirements on the coating properties can imply how the process should be designed.

Course Content

- Plasma-assisted technologies, general attributes
- Useful criteria, basic relations and limits for plasma, classification of plasmas
- Generation of gas discharge plasma, plasma diagnostics
- Generation of vapor species, transport through medium, diffusion, condensation at the surface
- Consequences of the deposition process on film properties
- Fundamentals of radical and ion-assisted plasma chemistry
- Homogeneous and heterogeneous plasma-assisted reaction in deposition of films
- Examples of novel plasma processes
- Hybrid plasma processes

Instructors: Ladislav Bårdos and Hana Baránková, *Uppsala University and BB Plasma HB, Sweden*

Ladislav Bårdos is an Associate Professor at Uppsala University in Sweden and Research leader of the Plasma group at Angstrom laboratory. He received his PhD in 1978 from the Czech Acad. Sci. and a Doctor of Science degree from Charles University in Prague in 1995. In 1984 he was awarded the Czechoslovak State Prize for outstanding research results in the plasma deposition of thin films. He has more than 25 years of experience in the field of applied plasma physics and thin films. He has published over 100 scientific papers, designed several plasma sources for industry and has 15 Czech, 7 Swedish and several international patents. He runs a consulting company in plasma sources and processing technology. His primary interests are microwave plasmas, including downstream ECR and surface-wave generation, and particularly the radio frequency generated hollow cathodes and hybrid sources at both low and atmospheric pressures. Lad Bardos is TAC chair of a special session HeurEka at the SVC TechCon and a member of the SVC Publications Committee.

Hana Baránková is an Associate Professor at the Angstrom Laboratory, Uppsala University and Director of the interdisciplinary program on environmental applications of plasma. Her primary interests are innovation in coating technology, development of plasma sources, plasma processing and plasma treatment of surfaces and gases. She has published over 70 scientific papers and holds several industrial patents on plasma systems. She is an inventor of metastable assisted deposition and co-inventor of the Linear Arc Discharge (LAD) source, the Magnets-in-Motion concept in plasma sources and Fused Hollow Cathode and Hybrid Hollow Electrode Activated Discharge (H-HEAD) cold atmospheric plasma sources. Hana Baránková is currently serving on the SVC Board of Directors, is Director of TACs, TAC chair for Emerging Technologies and member of the Education, International Relations, Scholarship, and Student Sponsorship Committees. She acts as a consultant and is a co-founder of two companies, BB Plasma HB and BB Plasma Design AB.

Also available through the **On-Site Education Program**

C-208 | Sputter Deposition in Manufacturing

Tuesday, April 22

8:30a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

This course emphasizes issues of practical importance to those using sputtering as a manufacturing process. It is intended for engineers, scientists, and technicians who would like an understanding of the factors that influence product throughput, coating quality, and process robustness and reliability. The primary focus will be on the use of planar magnetrons of various shapes, but other sources will be covered as well. The relationships between the sputtering conditions and important film properties—such as microstructure, composition, stress, adhesion and the resulting mechanical, electrical, and optical characteristics—will be discussed. New developments that are finding their way into practical applications also will be highlighted. No prior formal training in sputtering is required to appreciate the course content.

Course Content

- Sputtering plasmas and the nature of the sputtering process
- Estimating deposition rates and rate limiting factors
- Cathode geometries and associated film thickness profiles
- Film composition and compositional uniformity
- Biased sputtering and the use of unbalanced magnetrons
- Sources of substrate heating
- rf sputtering of dielectrics from insulating targets
- The dc, pulsed dc, and ac reactive sputtering of dielectrics
- Process control methods for reactive sputtering
- Arcing, disappearing anodes, and other process stability issues
- Ion beam sputtering

Instructor: David Glocker, *Isoflux Incorporated*

David Glocker is President of Isoflux Incorporated, a manufacturer of magnetron equipment, which he founded in 1993. He has more than 20 years' experience in thin film research, development, and manufacturing and has taken a number of new processes from laboratory-scale feasibility studies through successful production. He is an inventor or co-inventor of 25 U.S. patents and an author of more than 25 research papers in the areas of sputter source design, plasmas and plasma characteristics, sources of substrate heating in sputtering, and the control of sputtering processes and sputtered film properties. He also is the co-editor of *The Handbook of Thin Film Process Technology*, a major reference work in the field.

Also available through the **On-Site Education** Program

C-315 | Reactive Sputter Deposition

Tuesday, April 22

8:30a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

This course covers the fundamental mechanisms and technology of high rate reactive sputter deposition of conducting and insulating thin films. Following a brief introduction to reactive sputtering, including discussion of basic issues, target choices, and system configurations, we examine the effects of reactive gas addition on target surface and glow discharge processes which control film growth rates. Deposition approaches used in reactive sputtering – dc, rf, magnetron, pulsed dc, and ion beam – are discussed and compared. Process control strategies (e.g.: flow, partial pressure, and target voltage, and multi-loop control) and their implementation are described in detail using numerous examples. The advantages and disadvantages of these different modes of operation are examined from the point of view of controlling film properties. Emphasis is placed on developing a sufficient understanding of reactive sputter deposition to provide direction in designing new processes. The effects of energetic particle irradiation (positive and negative ions and fast neutrals) on film properties are also discussed. Present and future trends in reactive sputter deposition are addressed.

Course Content

- Introduction to reactive sputter deposition of conducting and insulating thin films
- Target processes during reactive sputtering
- Glow discharge volume processes during reactive sputtering

- Deposition technologies used in reactive sputtering (dc, rf, magnetron, pulsed dc, ion beam)
- Process control strategies
- Particle irradiation effects during film growth
- Film properties
- Computer-based modeling

Instructor: Joe Greene, *D.B. Willett Professor of Materials Science and Physics, University of Illinois, and Past Director of the Frederick Seitz Materials Research Laboratory.*

For Joe Greene's profile, see C-311 (Saturday).

C-211 | Sputter Deposition onto Flexible Substrates

Tuesday, April 22

8:30a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

This course is intended for engineers, scientists, and others who are interested in sputter deposition onto polymer substrates in a roll-to-roll format. This course will emphasize practical aspects of the topics, and the treatment will be descriptive with little mathematics used. Some of the material presented overlaps with material presented in our other offering, "Basics of Vacuum Web Coating" (C-204). Feel free to contact the instructor if you feel uncertain about which course is most appropriate for your needs. There will be time dedicated to problem solving; bring your questions and problems and leave with new solutions and/or new directions.

Course Content

This course provides the participant with an introduction to:

- Markets for sputter-coated web products
- Vacuum technology for sputter web coating
- Substrate characteristics
- Web handling, web winding, and web cooling issues
- The sputter coating process
- Process and product monitoring methods
- Current topics in sputter web coating

Additionally, the notes provide extensive information and references to sputtering (written at several levels) and a comprehensive bibliography on sputter web coating.

Instructor: Donald J. McClure, *Acuity Consulting and Training*

For Donald McClure's profile, see C-204 (Saturday)

C-308 | Tribological Coatings

Tuesday, April 22

8:30a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

This course is intended for design engineers, materials scientists, and coatings developers who have a need to specify and develop coatings for tribological applications (i.e., those in which wear must be reduced or prevented and/or friction minimized). The coatings also may need to have corrosion-resistant properties to operate in arduous conditions. The course begins with a description of the mechanics of wear and discusses the problems of selecting coatings for optimal tribological performance. An overview of the main processes for producing tribological coatings is given, emphasizing vacuum deposition methods. Tribological test methods also are over-viewed, including tests for adhesion and mechanical properties. Coatings developed for enhanced tribological properties are described, and information is provided on some applications for these coatings.

Course Content

- Wear mechanisms and theories (adhesion, abrasion, erosion, fatigue, corrosion, etc.)
- Tribological and mechanical test methods (e.g., pin on disc, abrasive wheel, scratch adhesion, microhardness, etc.)
- Coating processes and selection
- Benefits of ceramic coatings by PVD methods

- Information on tribological coatings (e.g., metal nitrides, carbides, oxides, superlattices, multilayers, nanocomposites, DLC, etc., plus hybrid and duplex processes)
- Applications information (e.g., metal cutting and forming, molding, bearings, pumps, auto parts, etc.)

Instructors: Allan Matthews, *University of Sheffield, UK* and Bill Sproul, *Reactive Sputtering, Inc.*

Allan Matthews is Professor of Surface Engineering, in the Department of Engineering Materials at the University of Sheffield, UK. Prior to this appointment he was Director of the Research Centre in Surface Engineering at the University of Hull, UK. He has been working on plasma-assisted PVD processes for about 25 years. He spent his early career in the aerospace industry and subsequently carried out research into enhanced plasma-based coating and treatment processes as well as test and evaluation methods. He holds eight patents in these fields and has authored or co-authored over 250 publications, including the book, *Coatings Tribology* (Elsevier, 1994). He is a former Chair of the Executive Committee of the Advanced Surface Engineering Division of the AVS and has been a Symposium Committee member and a Proceedings Editor for the ICMCTF Conference for a number of years. He is Chair of the British Vacuum Council and a Co-Editor of the Elsevier journal, *Surface and Coatings Technology*.

Bill Sproul is the founder and owner of Reactive Sputtering, Inc. Prior to starting his own consulting firm, he worked at Advanced Energy Industries, the Borg-Warner Corporation, Northwestern University, Sputtered Films, Inc., and Reactive Sputtering, Inc. Throughout his career he has been involved with the sputter deposition of hard materials for wear and corrosion applications. He is the author or co-author of more than 139 technical papers. He has 11 patents to his credit, and he is the inventor of the high rate reactive sputtering process. He is a past president of the American Vacuum Society, and he chaired the International Conference on Metallurgical Coating and Thin Films three times. He currently is a co-editor for *Surface and Coatings Technology*, and he serves on the editorial board for *Vacuum*. He is an AVS Fellow and Trustee, and in 2003 he received the SVC Mentor Award and the AVS Thornton Award.

Also available through the **On-Site Education Program**

M-102 | Introduction to Ellipsometry

Tuesday, April 22

8:30a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

Ellipsometry is becoming an important characterization technique for optical coatings. This course will build an understanding of ellipsometry fundamentals. We start with a basic description of polarized light, optical properties of materials, and the interaction between light and thin films. Different optical metrology tools will be compared with ellipsometry. A special focus will be placed on the merits of spectroscopic, variable angle, and in-situ ellipsometry. The applications of ellipsometry include measurement of single and multi-layer film thickness, complex refractive index, birefringence, porosity, conductivity, and composition. A wide range of ellipsometry applications will be surveyed, with emphasis toward optical coatings.

The level of this course is suitable for those new to the field of optical characterization but also contains worth-while information for current ellipsometry users. It will help anyone interested in exploring the potential of ellipsometry measurements.

Course Content

- Principles of ellipsometry
- Optical constants
- Light-Matter interaction
- Comparison of optical metrology tools
 - Spectrophotometry (R & T)
 - Polarimetry
 - Single-wavelength ellipsometry
 - Spectroscopic ellipsometry
 - Variable Angle ellipsometry
 - *In-situ* ellipsometry
- Survey of applications

Instructor: James N. Hilfiker, *J.A. Woollam Co., Inc.*

James N. Hilfiker graduated from the Electrical Engineering Department of the University of Nebraska in 1995. His graduate research involved in situ ellipsometry and optical characterization of magneto-optic thin films. He joined the J.A. Woollam Company upon graduation and has worked in their applications lab for over 11 years. He has authored over 30 technical articles involving Ellipsometry, including a couple of Encyclopedia chapters and a recent book chapter on *Vacuum Ultraviolet Ellipsometry*.

>> Wednesday, April 23

C-212 | Troubleshooting for Thin Film Deposition Processes

Wednesday, April 23

8:30a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

Vacuum deposited thin films are used for optical coatings, electrically-conductive coatings, semiconductor wafer fabrication, and a wide variety of other uses. They may be deposited on glass, plastic, semiconductors, and other materials. Usually, a vacuum deposition process produces durable, adherent films of good quality. But what do you do when things go wrong? Not all films can be deposited on all substrate materials. Sometimes films peel off or crack. Other times they are cloudy, absorbing, scattering, or have other unacceptable properties.

This course will teach you about techniques and tools that can be used to identify the source of the problems, correct the process, and get back into production. It will also help in learning how to develop new processes and products. The course is designed for process engineers and technicians, quality control personnel, thin film designers, and maintenance staff.

Course Content

- Mechanical, electrical, and optical properties of thin films
- Process parameters that affect film properties
- Gauge and instrument calibration
- Properties of substrate surfaces
- Measurement of film stress
- Detection of contamination
- Introduction to surface analysis techniques (Auger, ESCA, SIMS, FTIR)
- Substrate preparation and cleaning

Instructor: Gary S. Ash, *Castle Brook Corporation*

Gary S. Ash is President of Castle Brook Corporation, Dartmouth, MA. The company provides technical and management consulting services for the vacuum and cryogenics industry. He has had more than 35 years of experience in vacuum systems, pumps and other components, deposition processes ranging from evaporation to sputtering to molecular beam epitaxy. Engineering experience includes equipment and process design, manufacturing process development, materials and failure analysis, and applications support. In addition, he has had extensive experience in product strategy, development, and manufacturing planning for industrial products and services. He was previously employed by the CTI-Cryogenics division of Helix Technology Corporation, ASTeX, RIBER division of Instruments SA, Optical Coating Laboratory Inc., Spectrum Systems division of Barnes Engineering Co., AAI Corporation, and American Electronic Laboratories. He holds BS and MS degrees in electrical engineering from Cornell University and a PhD in optical physics from Heriot-Watt University, Edinburgh, Scotland.

Also available through the **On-Site Education Program**

C-317 | The Practice of Reactive Sputtering

Wednesday, April 23

8:30a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

This course is intended for engineers, technicians, materials scientists, and coating developers, who have a desire and need to understand how the reactive sputter deposition process really works. The goal of the course is to give the student a thorough understanding of all of the factors that affect the reactive sputtering process in order that the student can apply this knowledge to improve their reactive deposition process and achieve both high deposition rates and excellent film properties.

This course covers the basics of reactive sputtering followed by a comparison of the use of flow control versus partial pressure control of the reactive gas. The latter allows operation in the transition region between the metallic and poisoned states of the target, and films can be deposited at much higher rates with excellent properties using partial pressure control compared to flow control of the reactive gas. Along with using partial pressure control, it is important to use the right type of power to assure that there is no arcing during the deposition. Which type of power to use and along with which partial pressure sensor are reviewed. Large area coating presents special challenges for the control of the reactive gas, and the need for multiple gas inlets along the length of a long cathode and sensing in each gas inlet zone are discussed. The requirements

for a partial pressure control system along with commercially available controllers are presented. Multiple gas reactive sputtering and reactive high power pulsed magnetron sputtering (HPPMS) are emerging areas that are advancing the state of the art for reactive sputtering. How they work and what factors are important for controlling these two processes are discussed.

Course Content

- Basics of reactive sputtering
- Flow control versus partial pressure control of the reactive gas
- Power supplies for reactive sputtering
- Reactive gas sensors
- Large area reactive sputtering
- Control systems for reactive sputtering
- Multiple gas reactive sputtering
- Reactive high power pulsed magnetron sputtering

Instructor: Bill Sproul, *Reactive Sputtering, Inc.*

For Bill Sproul's profile, see C-308 (Tuesday)

C-318 | Nucleation and Growth of Nanostructures

(The materials science of small things: self-assembly and self-organization in inorganic systems)

Wednesday, April 23

8:30a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

Course Objectives

- Understand the primary experimental variables and surface reaction paths controlling nucleation/growth kinetics and microstructural evolution during vapor-phase deposition.
- Learn about the primary classical and quantum effects which controllably alter the properties of increasingly small nanostructures.
- Understand the mechanisms controlling self-assembly and self-organization during nanostructure growth.
- Learn how to better design nanostructure growth processes.

Course Description

The study of nanotechnology is pervasive across widespread areas including microelectronics, optics, magnetics, hard and corrosion resistant coatings, mechanics, etc. Progress in each of these fields depends upon the ability to selectively and controllably deposit nanoscale structures with specified physical properties. This, in turn, requires control – often at the atomic level – of nanostructure, nanochemistry, and cluster nano-organization.

Decreasing the size of solid clusters can result in dramatic property changes due to both “classical” effects associated with changes in average bond coordination and, as cluster sizes become of the order of the spatial extent of electron wavefunctions, quantum mechanical effects. The course will start with examples including reduced melting points, higher vapor pressures, increased optical bandgaps, decreased magnetic hysteresis, and enhanced mechanical hardness. Essential fundamental aspects, as well as the technology, of nanostructure formation and growth from the vapor phase will be discussed and highlighted with “real” examples using insights obtained from both *in-situ* and post-deposition analyses.

Nanostructure case studies include:

- Examples of template, size, and coarsening effects: self-assembled Si/Si(001), Cu/Cu(001), TiN/TiN(001), TiN/TiN(111) nano-clusters,
- Examples of controlled template plus strain effects: self-organized Ge wires on Si(111), Ge wires on Si(187 72 81), Au chains on Si(553), InAs metal wires on GaAs(001), insulated metal wires on Si(111),
- Quantum dot engineering: formation, shape transformations, and ordering in self-organized SiGe/Si(001); InAs/GaAs(001), CdSe/ZnSe(001), PbSe/PbEuSe(111), Ag/Pt(111), and MnN/Cu(001) quantum dots,
- Nano-catalysis: Au/TiO₂, and
- Examples of 3D nanostructures: (Ti,Ce)N/SiO₂, TiB_x/SiO₂, and d-TaN/g-Ta₂N/SiO₂.

Course Content

The course provides an understanding of:

- The classical and quantum effects controlling the dramatic property changes observed in nanostructures as a function of cluster size and dimension (3D -> 2D -> 1D)
- Self-assembly and self-organization during film growth
- Nucleation and growth modes
- The role of the substrate template in mediating growth kinetics
- The development, and control, of film stress (strain engineering)
- The use of film stress to controllably manipulate nanostructure
- Other mechanisms (including surface segregation, surfactant effects, low-energy ion bombardment, cluster coarsening, etc) for controlling nanostructures
- The design of nanostructures with specified properties.

Instructor: Joe Greene, *D.B. Willett Professor of Materials Science and Physics, University of Illinois, and Past Director of the Frederick Seitz Materials Research Laboratory.*

For Joe Greene's profile, see C-311 (Saturday)

C-304 | ITO and Other Transparent Conductive Coatings: Fundamentals, Deposition, Properties, and Applications

Wednesday, April 23

8:30a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

This course is intended for scientists, engineers, technicians, and others, interested in understanding the deposition and properties of transparent conductive coatings (TCCs). The major topic of the course is indium tin oxide, ITO. Deposition by dc magnetron sputtering is emphasized although all common deposition processes are described. Specific examples of the ITO properties achieved with evaporation, reactive and ceramic target sputtering deposition processes are shown. Post-deposition processing also is discussed. A methodology is described for developing an ITO (or any TCC) deposition process in your own equipment. Typical ITO properties are compared with those achieved by metals and metal nitrides TCC (alternative TCO to ITO are not discussed – see C-321). The selection and design of a TCC to meet the requirements of a particular application are presented. Some knowledge of basic thin film coatings and

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Can't make it to the TechCon? The majority of the SVC courses offered at the TechCon are available through our On-Site Education Program. Look for the phrase above to identify courses that can be brought to a facility of your choice.

Interested in more information regarding cost, arrangements, etc.? Please contact the SVC at 505/856-7188 or E-mail: svcinfo@svc.org. A complete roster of SVC Short Courses available in the On-Site Education Program is available

on-line at www.svc.org. For a detailed course description, and biographical sketch of the instructor, you may click on the course title.

interference optics is assumed, although key basics will be reviewed. The course will briefly cover the basic physics and fundamentals of conductivity. A prior introductory solid state physics course would be helpful but is not required. Time will be available for questions concerning your process problems.

Course Content

- Basic physics of transparent conductive coatings (TCCs)
- Major deposition methods for TCCs
- Control of TCC Film Properties
- Selection of deposition method and process conditions
- TCC performance in applications
- Manufacturing issues
- Advanced topics—p-Type TCO

Instructor: Clark Bright, *3M Corporation*

Clark Bright is a Senior Staff Scientist and Group Technical Leader with 3M Corporation. He is directing the development and scale-up of processes for vacuum deposition of multilayer organic and inorganic thin film products. He previously was Vice President at Presstek, Inc., and its Delta V Technology subsidiary, where he directed the R&D of transparent conductive oxides, barrier coatings, polymer multilayer (PML) technology, and custom vacuum coating equipment. While at Southwall Technologies, as Director of Product Development he led the development of a web coating process for sputter depositing a durable, conductive (ITO), multilayer antireflection coating on plastic film used on CRT computer monitors. He has published and presented numerous papers on optical coatings and holds 11 patents in the field.

V-207 | Practical Aspects of Vacuum Technology: Operation and Maintenance of Production Vacuum Systems

Wednesday, April 23

8:30 a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

This course is designed to teach the basic fundamentals of vacuum technology to technicians, equipment operators, line process operators, and maintenance personnel. This course will address how to use and maintain an existing vacuum effectively, not how to design a system. The introduction will consist of a very basic explanation of what a vacuum is and how it is attained and proceeds to an explanation of the three gas flow regimes (i.e., viscous, transition, and molecular flow). This is followed by a description of the types of pumps used in the viscous flow region (e.g., mechanical displacement pumps, venturi/suction pumps, and sorption pumps). Types of high vacuum pumps are next discussed; these include diffusion pumps, turbopumps, and cryopumps.

The next section deals with the care and maintenance of pumps and vacuum systems, including both compressible “rubber” gasket and metal gasket systems. The unique role that water plays in both pumpdown from atmosphere and in outgassing will be addressed, and techniques to ameliorate its harmful effects will be presented. The effects of other unique “bad actors” will be discussed also. Many useful charts and tables will be presented and explained.

Participants are requested to present any problems or difficulty that they may be experiencing with their vacuum systems for discussion. This makes for very interesting examples, and the problem might actually be solved.

Course Content

- Introduction to vacuum
- Explanation of the three gas flow regimes
- Viscous flow pumps
- High vacuum pumps
- Care and maintenance of pumps and vacuum systems, including both compressible “rubber” gasket and metal gasket systems
- Evaluating system performance: pumpdown rate and leak-up rate
- Leak detection and correction
- Cleaning and conditioning of vacuum components and system
- Operation of vacuum systems: crossover pressure, interlocks, and safety
- Applications of vacuum systems for vacuum coating
- Pumpdown and outgassing
- Descriptions of other vacuum related courses presented by SVC

Instructor: Robert A. Langley, *Oak Ridge Scientific Consultants*

Robert A. Langley is retired from Oak Ridge National Laboratory and Sandia National Laboratories. He has performed research in the fields of atomic and molecular physics, solid state physics, material science, vacuum science, upper atmospheric phenomena, fusion power, and high-energy accelerators. He has also worked at the International Atomic Energy Agency in Vienna, Austria. He continues to publish scientific articles and has published over 130 scientific papers.

Also available through the **On-Site Education** Program

>> Thursday, April 24

C-306 | Non-conventional Plasma Sources and Methods in Processing Technology

Thursday, April 24

8:30a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

This course is a new edition of a well-established annual course started in 1997. It is intended for anyone using or planning to use plasma processing technology, including cold atmospheric plasma sources and applications. Extensive applications of plasma processing are accompanied by an intense development of different new plasma sources and methods (e.g., afterglow and downstream plasmas, pulsed plasmas, inductively coupled plasmas and helicons, dc and rf hollow cathode plasmas, atmospheric plasmas, etc.). The course covers both the explanation of basic physical and technical principles of conventional and non-conventional systems and typical examples of their applications. This is very important not only for adopting new plasma technologies and easier orientation in a new market, but also for better understanding of conventional commercialized systems.

Course Content

- Gas discharge plasma - definition, characterization and generation principles.
- Fundamentals of plasma processing, conventional plasma sources and systems.
- Decaying plasmas and afterglows, time and space resolved afterglows, pulsed plasmas, hybrid plasma systems and processing.
- Microwave plasmas, ECR plasma, surfatron and surfaguide afterglows for PCVD of films.
- Novel radio frequency (rf) plasma systems, inductively coupled plasma (ICP) and helicons.
- Hollow cathode plasma sources (principles and basic applications), dc- and rf-generated hollow cathodes, linear hollow cathodes for large area processing.
- Classification of arcs, arc evaporation of films from rf hollow cathodes, vacuum arcs, metastable-assisted regimes in hollow cathodes.
- High density plasma sputtering.
- Magnets-in-motion concept in plasma sources, linear magnetized hollow cathodes.
- Cold atmospheric and subatmospheric plasma sources, corona and dielectric barrier discharges (DBD), microwave atmospheric plasma, fused hollow cathode discharge.
- Advantages and limits of the atmospheric plasma sources and applications.

Instructors: Ladislav Bãrdos and Hana Barãnková, *Uppsala University and BB Plasma HB, Sweden*

For the instructor's profiles, see C-210 (Monday).

Also available through the **On-Site Education** Program

C-319 | Introduction to Energy Conversion Materials and Technology

Thursday, April 24

8:30a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

With the high price of fossil fuels, there is a renewed emphasis on energy conservation and development of alternative energy resources and systems. As a result, there is renewed emphasis on low cost energy conver-

sion materials. Many of these systems were initially developed for space power sources. Fuel cells (including PEM, solid oxide and thin film) convert hydrogen and hydrocarbon fuels to electrical power and are being developed as an alternate power source for automobile engines. Thermoelectric power generation systems are being developed to recover energy from industrial and vehicle waste heat sources. Semiconductor photovoltaics have been around with us for a long time and harvests light from the sun and thermophotovoltaics converts photons from heat sources to useable energy. Organic photovoltaics are just starting to achieve respectable efficiencies and can be made over large areas. Thermionics converts electrons from a hot body into electricity. Nuclear reactions (beta decay) are used as the heat source for thermoelectric power generation. Thin film batteries convert chemical energy into electrical energy. Most of these energy conversion systems are utilized by the space program but have experienced recent significant improvements in performance. They are extremely useful in powering remote sensors and surveillance systems. This course will review several energy conversion technologies and how thin film materials are helping to advance these technologies. These new materials are helping to improve conversion efficiencies. Recent development in organic materials will also be presented.

Course Content

- Semiconductor solar cells
- Thin film solar cells
- Graztel cells
- Organic solar cells
- Transparent solar cells
- Thermophotovoltaics
- Solar thermal energy
- Photocatalytic materials
- Thermoelectric power generation
- Thermionic power generation
- PEM fuel cells
- Solid oxide fuel cells
- Thin film fuel cells
- Thin film Li batteries
- How MEMS is advancing energy systems
- Space power systems
- Remote power systems

Instructor: Peter M. Martin, *Pacific Northwest National Laboratory (retired)*

Peter Martin - Dr. Martin has worked at Pacific Northwest National Laboratory for thirty years, where he currently holds the position of Laboratory Fellow Emeritus, and specializes in developing thin film coatings for energy, biomedical, space and defense applications. He pioneered the use of reactive magnetron sputtering technology to fabricate novel coatings, superlattice and quantum well materials and engineered coatings with improved durability, adhesion, and performance. He also specializes in large-area coating development. He is currently President of the Society of Vacuum Coaters, Executive Editor for Vacuum Technology & Coating magazine, and Technical Advisory Committee member for the Society of Vacuum Coaters. He was elected a Fellow of SVC in 2003. He has written over 200 technical publications, given over 200 technical presentations, won three R&D 100 Awards for his work in microfabrication and barrier coatings for flat panel displays, two FLC awards, Battelle Technology of the Year, 2003, for his work with the photolytic artificial lung, distinguished inventor, and PNNL 2005 Inventor of the Year. He has twenty six patents and numerous pending patents in microtechnology, coatings technology, thermoelectrics and barrier coating areas.

C-207 | Evaporation as a Deposition Process

Thursday, April 24

8:30a.m.—4:30 p.m.

Course fee: \$520

Student fee: \$95

Evaporation is a technology used widely to produce thin films in vacuum. The course describes the basics of evaporation and its utilization in various technological processes. The course provides the conceptual basis for a wide range of evaporation techniques. It is designed to meet the needs of both a newcomer to the field and the experienced professional. Experienced scientists and engineers will have an opportunity to broaden their view of this field and deepen their understanding of evaporation processes.

Course Content

- Thin film deposition in vacuum
- Evaporation mechanism—Thermodynamic of evaporation, evaporation rate, vapor pressure of elements, evaporation of compounds, evaporation of alloys
- Film thickness uniformity and purity—Deposition geometry, film thickness uniformity, conformal coverage, film purity, deposition rate monitoring and process control
- Evaporation sources—General considerations, resistance heated sources, sublimation sources, induction heated sources, electron beam heated sources, arc evaporation, laser ablation
- Reactive evaporation—Reactive and activated reactive evaporation
- Ion-assisted evaporation—Ion plating, enhanced ion plating, plasma-assisted deposition, ion-beam-assisted deposition
- Microstructure of evaporated thin films—Film growth mechanisms, structural zones, ion-assisted growth
- Deposition systems for thin film deposition by evaporation—Major parts of the system, web coatings systems, vacuum batch systems
- When should we use evaporation as a deposition process

Instructor: Abe Belkind, *Abe Belkind & Associates*

Abe Belkind has 15 years of research and development experience in industry and more than 20 years in academia. From 1981 to 1996 he was a Lead Scientist for BOC Coating Technology, where he investigated and developed vacuum and plasma technologies for the deposition of thin film coatings. In 1996, he became an Adjunct Professor in the Department of Chemical, Biochemical and Materials Engineering at the Stevens Institute of Technology in Hoboken, NJ. In 1997, he created a consulting company, Abe Belkind & Associates, Inc. He is an expert in various technologies for depositing and designing metal alloy, oxide, carbide, nitride and other thin films; plasma surface cleaning and treatment; and methods of film analysis. He has received 10 patents, published a book, and written more than 100 technical papers. Dr. Belkind is the recipient of a BOC Group Technology award and two awards from the Latvian Academy of Science.

Also available through the **On-Site Education** Program

New!

C-321 | Alternative Transparent Conductive Oxides (TCOs) to ITO (half-day)

Thursday, April 24

8:30a.m.—12:30 p.m.

Course fee: \$365

Student fee: \$70

This course is intended for scientists, engineers, technicians, and others, interested in understanding the options and issues in selecting an alternative TCO to indium tin oxide, ITO, the most common TCO. Alternative TCOs will be discussed for cost sensitivity applications, performance driven applications and the many cases in which a compromise between cost and performance must be made. Typical ITO properties are summarized and compared with those achieved by emerging TCO coatings. A methodology is developed for selecting and engineering the alternative TCO coating to meet the requirements of a particular application.

It is recommended that SVC course, C-304 "ITO and Other Transparent Conductive Coatings: Fundamentals, Deposition, Properties and Applications" be taken prior to this course. Some knowledge of introductory solid state physics, the fundamentals of conductivity, thin film optical interference coatings and common vacuum deposition methods is assumed.

Course Content

- Introduction
- Performance expectations – ITO baseline
- TCO replacement candidates
- Cost OR performance driven alternative?
- Cost AND performance – Compromise
- Performance Beyond E/O Properties
- TCO performance in applications

Instructor: Clark Bright, *3M Company*

For Clark Bright's profile, see C-304 (Wednesday).

C-320 | Diamond Like Carbon Coatings – from Basics to Industrial Realization (half-day)

Thursday, April 24

8:30a.m.—12:30 p.m.

Course fee: \$365

Student fee: \$70

This course is recommended for engineers and R&D staff members, who are involved in specifying new designs and surface treatments for components and tools. The application of Diamond Like Carbon, often in combination with pre-treatments like plasma nitriding and polishing, allows much improved wear resistance (abrasive, adhesive, fatigue) and to reduction of friction forces. Under the umbrella name of DLC, various classes of coatings have been developed, where each class of coatings has its own deposition technology and coating characteristics.

The industrial applications are presently mainly in components for e.g. automotive, aerospace, general machine building.

Course Content

- *Basics and standardization*
 - Classification of different DLC's
 - DLC's in comparison to diamond films
 - Structure of hydrogen free and hydrogenated DLC's
 - Mechanical properties of DLC's
 - Tribological behaviour of DLC's
 - Carbon based coating systems
- *Technology and processes*
 - PVD processes for deposition of hydrogen free DLC films
 - Plasma assisted CVD processes for preparation of a-C:H and modified a-C:H:X coatings
 - Hybrid processes
 - Duplex processes
 - Sputter deposition of metal containing a-C:H:Me coatings
 - Sputter deposition of metal free a-C:H coatings
 - Improved coating adhesion by interlayer systems
- *Industrial applications*

New Courses on Hot Topics Offered in 2008!

- ◆ *High Power Impulse Magnetron Sputtering (C-323)*
 - ◆ *Characterization of Thin Films (C-322)*
 - ◆ *Alternative Transparent Conductive Coatings (TCOs) to ITO (C-321)*

- Contact modes and wear mechanisms
- Coating design for specific wear mechanisms
- Industrial DLC applications
- Industrial deposition methods
- Representative industrial examples
- Near future expectations

Instructors: Thomas Schuelke, *Fraunhofer USA*, Klaus Bewilogua, *Fraunhofer-Institute, Braunschweig, Germany* and Gerry van der Kolk, *Ionbond Netherlands b.v., Venlo, The Netherlands*

Thomas Schuelke holds M.Sc. and Ph.D. degrees in physics and has worked for the Fraunhofer Society for thirteen years. He gained industrial experience in the semiconductor industry. Currently he manages Fraunhofer USA's activities in advanced industrial coating technologies. His team performs applied R&D projects for industry and government with a focus on carbon-based materials.

Klaus Bewilogua studied physics at the Technical University in Dresden, Germany, and completed his thesis in 1973. In the following time he was research assistant at the Technical University in Chemnitz, Germany, where he worked on structure analyses of amorphous materials and on the plasma assisted deposition of hard coatings. 1983 he qualified for lecturer. In 1990 Klaus Bewilogua joined the Fraunhofer Institute for Surface Engineering and Thin Films in Braunschweig, Germany. As head of a department he is responsible for R&D in the field of hard coatings, especially diamond-like carbon and cubic boron nitride.

Gerry van der Kolk studied physics and received his Ph.D at Delft University. His working experience is partly R&D (Delft University, Philips Research, Brookhaven NL), partly equipment building (Gemco, Hauzer). His present position is Director of Ionbond Europe and global co-ordinator for the segment Components, in which he is involved in application development of DLC's.

SVC Foundation Scholarship Program...

because technical education is the driving force behind the innovations that improve our lives.

Each year, the SVC Foundation awards several scholarships in amounts ranging from \$2,500 to \$5,000 to outstanding undergraduate or graduate students.

If you are studying **or working** in vacuum coating technology or a related field, you could qualify for a scholarship from the Society of Vacuum Coaters Foundation. Past awardees are eligible to apply again.

Deadline for application is January 31.

Applications are available at www.svc.org/SF/SVCFoundationSchol.html



Society of Vacuum Coaters Foundation, Inc.

8100 M-4 Wyoming Blvd. NE #243, Albuquerque, NM 87113 USA

E-mail: svcfoundation@svc.org

Web Site: www.svc.org/SF/SVCFoundationSchol.html

SVC 2008 TechCon Registration for TechCon and Short Course Registrants, Personnel from an Exhibiting Company, Media Personnel, and Exhibit Visitors

The On-line Registration process at www.svc.org will guide you through the registration steps.

If you are unable to register on-line, you may use the form on the inside back cover of this brochure.

- 1. Conference Registrant** (including presenters and students)
Complete the full registration form including the payment section
- 2. Invited Presenter ONLY** (already approved by the Program Chairs)
No fee is required but it is necessary to complete the full registration form
- 3. Short Course Registrant ONLY** (including students)
Note: It is not necessary to register for the TechCon in order to register for courses or visit the Exhibit.
- 4. Personnel from an Exhibiting Company**
Individuals from Exhibiting companies who wish to register for the TechCon or short courses have a special path to follow using the On-line Registration System, and a special box to check on the Conference Registration form (opposite).

It is strongly recommended that Exhibit booth contacts ask their booth personnel to individually register for the TechCon if using the On-line Registration System, since there are opportunities to register for other events (such as the House of Blues Networking Event) and/or purchase other products.
- 5. Media Personnel ONLY**—No fee is required
- 6. Exhibit Visitor ONLY**—No fee is required.

General Conference Information

- **Special reduced TechCon registration fees** apply to students and member/nonmember presenters.
- All Conference registrants will receive a copy of the **CD-ROM for the 1991–2008 Conference Proceedings** to be released in the fall of 2008.
- Conference registrants (ONLY) are eligible to purchase the **printed Conference Proceedings** at the special rate of \$40 (plus \$15 for shipping outside North America).
- **Register early!** Individual short course fees and conference registration fees are **\$100 higher** than the fees in this Preliminary Program after March 29, 2008.

- Only Conference registration and short course cancellations received on or before March 29, 2008, will be refunded. Refunds will be made upon receipt of a written notice, less a \$25 service fee for the TechCon and each individual course. **No refunds will be made for cancellations received after March 29, 2008.**

Membership Issues—Please Note!

You must pay your 2008 Membership Dues before you can register for the TechCon at the “Member Rate” and reserve your room for the Conference. If your 2008 Membership dues have not been paid when registering on-line for the TechCon at the “Member Rate”, you will be required to pay the dues during the registration process.

Special Needs

If you have disability or dietary needs, please contact SVC with the details.

On-Site Registration

SVC Registration is located in the Grand Ballroom Registration area in the East Tower of the Hyatt Regency Chicago. If you are not attending a short course, please pick up your badge after 8:30 a.m. if possible.

Saturday April 19 7:15 a.m.–10:00 a.m.	Tuesday April 22 7:15 a.m.–5:00 p.m.
Sunday April 20 7:15 a.m.–8:00 p.m.	Wednesday April 23 7:15 a.m.–5:00 p.m.
Monday April 21 7:15 a.m.–7:00 p.m.	Thursday April 24 7:30 a.m.–11:30 a.m.

Conference Registration Fees

- **TechCon Registration fees include the following social/networking events:**
Welcome Reception on Sunday, April 20
Reception in the Exhibit Hall on Monday, April 21
Luncheon in the Exhibit Hall on Monday and Tuesday, April 21 and 22
Technology Forum Breakfasts on Tuesday and Wednesday, April 22 and 23
- **SVC Memeberhip for 2008 is provided to those paying the Non-member fee.**

Short Courses Offered at the 2008 TechCon

- SVC reserves the right to cancel any course. If a course is cancelled registrants will be notified, and a full refund of tuition will be made.
- A Discount package price of \$1,350 (\$425 for students) is available (with only one textbook included) if you register for V-201, V-202, and V-203 on Saturday, Sunday, and Monday.

Saturday, April 19

- V-201** High Vacuum System Operation (includes text)
- C-103** Introduction to Physical Vapor Deposition (PVD) Processes (includes text)
- C-204** Basics of Vacuum Web Coating
- C-311** Thin Film Growth and Microstructure Evolution

Sunday, April 20

- C-203** Sputter Deposition (2-days Sunday & Monday)
- V-202** Vacuum System Gas Analysis
- C-301** Optical Coating Design and Monitoring (includes text)
- C-314** Plasma Modification of Polymer Materials and Plasma Web Treatment
- C-323** High Power Impulse Magnetron Sputtering **NEW**
- C-322** Characterization of Thin Films **NEW**

Monday, April 21

- V-203** Vacuum Materials and Large System Performance (includes text)
- C-302** Practical Aspects of Optical Coatings
- C-101** Primer on Thin Films and Vacuum Technology
- C-210** Introduction to Plasma Processing Technology (half-day p.m.)

Tuesday, April 22

- C-208** Sputter Deposition in Manufacturing
- C-315** Reactive Sputter Deposition

- Short course fees include attendance at the following social event.
Reception in the Exhibit Halls on Monday, April 21
- Courses are full day (8:30 a.m. to 4:30 p.m.) unless otherwise noted. The schedule for half-day courses are either (8:30 a.m. to 12 noon) or (1:00 p.m. to 4:30 p.m.) as denoted by morning and afternoon respectively.

C-211

- Sputter Deposition onto Flexible Substrates
- C-308** Tribological Coatings
- M-102** Introduction to Ellipsometry

Wednesday, April 23

- C-212** Troubleshooting for Thin Film Deposition Processes
- C-317** The Practice of Reactive Sputtering
- C-318** Nucleation & Growth of Nanostructures
- C-304** ITO and Other Transparent Conductive Coatings: Fundamentals, Deposition, Properties, and Applications
- V-207** Practical Aspects of Vacuum Technology: Operation & Maintenance of Production Vacuum Systems

Thursday, April 24

- C-306** Nonconventional Plasma Sources and Methods in Processing Technology
- C-319** Introduction to Energy Conversion Materials and Technology
- C-207** Evaporation as a Deposition Process
- C-321** Alternative Transparent Conductive Coatings (TCOs) to ITO (half-day a.m.) **NEW**
- C-320** Diamond Like Carbon Coatings – from Basics to Industrial Realization (half-day a.m.)

Conference Registration Form

Full Name: _____

Title: Equipment Development Engineering Process Development Engineering Staff Scientist R&D or Production Manager Marketing/Sales Manager
 Technician/Operator R&D or Professor Student: Undergraduate/Graduate/Post Graduate Other _____

Organization: _____

Address: _____

City: _____ State: _____ Zip/Postal: _____ Country: _____

Phone: _____ Fax: _____ E-mail: _____

How did you learn about the SVC Technical Conference? <input type="checkbox"/> SVC Communication <input type="checkbox"/> Bulletin <input type="checkbox"/> Call for Papers/Exhibit Prospectus <input type="checkbox"/> Marketing E-mail <input type="checkbox"/> TechCon Exhibit Guide <input type="checkbox"/> SVC Web Site <input type="checkbox"/> Preliminary Program <input type="checkbox"/> Colleague <input type="checkbox"/> Other/Magazine _____	Is this your first visit to the SVC TechCon? <input type="checkbox"/> Yes <input type="checkbox"/> No Please indicate any Special Needs: <input type="checkbox"/> Dietary <input type="checkbox"/> Disability	Which Sector best describes your Company? <input type="checkbox"/> Industry <input type="checkbox"/> Research Institute <input type="checkbox"/> Academia <input type="checkbox"/> Equipment Supplier <input type="checkbox"/> Government <input type="checkbox"/> Consultant <input type="checkbox"/> Other _____	May we share your contact information with our Sponsors? <input type="checkbox"/> Yes <input type="checkbox"/> No
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Attendee Registration	Member [‡]	Non-Member
	(through 3/29/08/after 3/29/08)	(through 3/29/08/after 3/29/08)
<input type="checkbox"/> Full Conference	\$540.00/\$640.00	\$730.00/\$830.00
<input type="checkbox"/> Invited Presenter	\$0.00	\$0.00
<input type="checkbox"/> Presenter in Technical Sessions <i>Note: Presenter Rate does not apply to co-authors</i>	\$225.00/\$325.00	\$415.00/\$515.00
<input type="checkbox"/> Media Personnel	\$0.00	\$0.00
<input type="checkbox"/> Student Conference	\$65.00	\$65.00
<input type="checkbox"/> Student Presenter in Technical Sessions	\$40.00	\$40.00
<input type="checkbox"/> Short Course(s) Only	See Fees Below	See Fees Below
<input type="checkbox"/> Exhibit Visitor Only	\$0.00	\$0.00

[‡]Member Fee applies only to those who have paid their 2008 Membership Dues. If the fee has not been paid and the Member rate is checked, then SVC will charge the membership dues to the credit card provided.

Exhibitor Registration	Member [‡]	Non-Member
	(through 3/29/08/after 3/29/08)	(through 3/29/08/after 3/29/08)
<input type="checkbox"/> Exhibitor Booth Personnel	\$0.00	\$0.00
<input type="checkbox"/> Exhibitor with Full Conference Registration	\$540.00/\$640.00	\$730.00/\$830.00
<input type="checkbox"/> Exhibitor Presenter in Technical Sessions	\$225.00/\$325.00	\$415.00/\$515.00

Short Courses Offered at the 2008 TechCon: It is NOT necessary to register for the Conference in order to attend a short course or visit the Exhibit. SVC reserves the right to cancel any course. If a course is cancelled registrants will be notified and a full refund of tuition will be made. **All course fees are \$100 higher after March 29, 2008 (this increase does not apply to students).** A **Discount package price of \$1,350 (\$425 for students)** is available (with only one text book included), if you register for V-201, V-202 and V-203 on Saturday, Sunday and Monday.

Saturday, April 19	Reg/Student	Sunday, April 20	Reg/Student	Monday, April 21	Reg/Student	Tuesday, April 22	Reg/Student	Wednesday, April 23	Reg/Student	Thursday, April 24	Reg/Student
<input type="checkbox"/> V-201*	\$625/\$190	<input type="checkbox"/> V-202*	\$625/\$190	<input type="checkbox"/> V-203*	\$625/\$190	<input type="checkbox"/> C-208	\$520/\$95	<input type="checkbox"/> C-212	\$520/\$95	<input type="checkbox"/> C-207	\$520/\$95
<input type="checkbox"/> C-103*	\$625/\$190	<input type="checkbox"/> C-203 (2-Day)	\$830/\$190	<input type="checkbox"/> C-101	\$260/\$45	<input type="checkbox"/> C-211	\$520/\$95	<input type="checkbox"/> C-304	\$520/\$95	<input type="checkbox"/> C-306	\$520/\$95
<input type="checkbox"/> C-204	\$520/\$95	<input type="checkbox"/> C-301*	\$595/\$190	<input type="checkbox"/> C-210	\$365/\$70	<input type="checkbox"/> C-308	\$520/\$95	<input type="checkbox"/> C-317	\$520/\$95	<input type="checkbox"/> C-319	\$520/\$95
<input type="checkbox"/> C-311	\$520/\$95	<input type="checkbox"/> C-314	\$520/\$95	<input type="checkbox"/> C-302	\$520/\$95	<input type="checkbox"/> C-315	\$520/\$95	<input type="checkbox"/> C-318	\$520/\$95	<input type="checkbox"/> C-320	\$365/\$70
		<input type="checkbox"/> C-322	\$520/\$95			<input type="checkbox"/> M-102	\$520/\$95	<input type="checkbox"/> V-207	\$520/\$95	<input type="checkbox"/> C-321	\$365/\$70
		<input type="checkbox"/> C-323	\$520/\$95								

*Textbook included with these courses.



Special Events at the TechCon

- Mr. Wizard Program** (Sunday afternoon) (Space is limited. First come—first seated) No fee
- SVC Foundation 5K Run** — T-Shirt Size S M L XL XXL \$25.00
- Newcomer's Reception** for first time attendees. No fee
- House of Blues** networking event (includes dinner and entertainment) on Monday evening
 _____ tickets at \$48 each = _____



Payment Information

Visa MasterCard American Express Discover Bank Transfer Check # _____ PO # _____

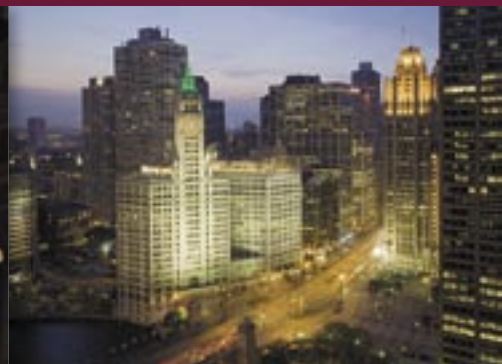
Credit Card Number: _____ Expiration: _____ Total Due _____

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Security number is on the back of your card. Visa/MC/DCVR - 3 digits. Amex - 4 digits. Print name as it appears on the card.

Signature: _____ Billing Zip: _____

51st Annual
**Technical
Conference**
of the Society of Vacuum Coaters

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*Join us for a night of delicious dining and
extraordinary entertainment at the*

CHICAGO HOUSE OF BLUES

*See page 8 inside for more information
on this SVC TechCon Networking Event!*

Sign up for the 3rd Annual SVC

5K FUN RUN & WALK

*Get up early on Tuesday and join your colleagues
for an early morning run! It's a great way to start the
day and benefits the SVC Foundation!*



Society of Vacuum Coaters
71 Pinon Hill Place NE
Albuquerque, NM 87122-1914 USA