



CALL FOR ABSTRACTS

The International Conference on Metallurgical Coatings and Thin Films (ICMCTF) is recognized as the premier international conference on thin film deposition, characterization, and advanced surface engineering. It provides a forum and networking venue for scientists, engineers, and technologists from academia, government laboratories, and industry. Attendees from all over the world come to present their findings, exchange ideas, share insights, make new friends, and renew old acquaintances. ICMCTF typically draws more than 800 attendees, covering over 50 oral technical sessions and a well-attended Thursday evening poster session.

ICMCTF 2022 will have eight technical symposia A through H and six topical symposia that pertain to the development of new coating materials and processes, novel methods of analysis and characterization, and approaches to scale-up for commercial applications. The conference will open with a plenary talk on Monday morning by Professor Christopher A. Schuh from the Massachusetts Institute of Technology, USA on "The fundamental physics of spray coatings and surface impacts: unit process studies of hypersonic particle impacts." Another special highlight of the meeting is our Exhibitors Keynote Lecture, presented by Dr. Vincent S. Smentowski, General Electric Research, USA. He will present on the topic of "Fabrication and Characterization of Industrially Important Films and Coatings." Three Special Interest Lectures given by top specialists will be featured throughout the conference week. Professor Christopher Muratore from the University of Dayton, USA will speak on "The versatility of transition metal dichalcogenide thin films: from high temperature tribology to ultrasensitive biomolecular detection." Professor Megan Cordill of the Austrian Academy of Sciences and the Montanuniversität Leoben, Austria will share her great experience on "Evaluating Electro-Mechanical Reliability using In-Situ Methods." Professor Pantcho Stoyanov, Concordia University, Canada (previously with Pratt and Whitney, USA) will talk about "Tribological Coating Solutions and Lubrication Strategies for Gas Turbine Engines."

In addition to the technical program, the conference features a two-day industrial exhibition, showcasing the latest in equipment, materials and services used for the deposition, monitoring, and characterization of coatings and thin films. The exhibition, which will be held Tuesday and Wednesday, May 24-25, will be open to the public. An educational program of Short Courses and Focused Topical Sessions (FTS) will be offered throughout the week. The program will also include a very special all-invited session to acknowledge the contributions of Professor Joe Greene to the ASED, ICMCTF, AVS, and IUVTSA.

Each year, the R.F. Bunshah and Bill Sproul Award Laureates and three outstanding Graduate Student Award winners are celebrated during a special convocation late Wednesday afternoon, May 25, followed by a festive reception in the evening. In addition, we will be recognizing our 2021 awardees.

ICMCTF will again publish excellent scientific and technical work in peer-reviewed issues of the two Elsevier journals *Surface and Coatings Technology* ($IF = 4.158$) and *Thin Solid Films* ($IF = 2.183$), so we strongly encourage all authors to submit manuscripts for consideration by May 6, 2022.

The Town and Country Resort Hotel and Convention Center, located in sunny San Diego of Southern California, will be the official conference venue, providing a relaxing atmosphere for discussion and networking among attendees.

Samir Aouadi
2022 Program Chair

Grzegorz (Greg) Greczynski
2022 General Chair

PROGRAM COMMITTEE

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SYMPOSIUM A: COATINGS FOR USE AT HIGH TEMPERATURES

Symposium Chairs:
Sebastien Dryepondt, Oak Ridge National Laboratory, USA, dryepondtsn@ornl.gov
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Francisco Javier Pérez-Trujillo, Universidad Complutense de Madrid, Spain, fjperez@ucm.es

A1. Coatings to Resist High-temperature Oxidation, Corrosion, and Fouling

Session Chairs:
Gustavo García-Martín, REP-Energy Solutions, Spain, gustavo.garcia@rep-energysolutions.com

Shigenari Hayashi, Hokkaido University, Japan, hayashi@eng.hokudai.ac.jp
Justyna Kulczyk-Malecka, Manchester Metropolitan University, UK, J.Kulczyk-Malecka@mmu.ac.uk

A2. Thermal and Environmental Barrier Coatings

Session Chairs:
Sabine Faulhaber, University of California, San Diego, USA, sfaulhaber@eng.ucsd.edu
Kang N. Lee, NASA Glenn Research Center, USA, ken.k.lee@nasa.gov
Pantcho Stoyanov, Concordia University, Canada, pantcho.stoyanov@concordia.ca

SYMPOSIUM B: HARD COATINGS AND VAPOR DEPOSITION TECHNOLOGIES

Symposium Chairs:
Anders Eriksson, Oerlikon Balzers, Oerlikon Surface Solutions AG, Liechtenstein, anders.o.eriksson@oerlikon.com
Farwah Nahif, eifeler-Vacotec GmbH, Germany, farwah.nahif@eifeler-vacotec.com
Jyh-Ming Ting, National Cheng Kung University, Taiwan, jting@mail.ncku.edu.tw

B1. PVD Coatings and Technologies

Session Chairs:
Frank Kaulfuss, Fraunhofer Institute for Material and Beam Technology (IWS), Germany, frank.kaulfuss@iws.fraunhofer.de
Vladimir Pankov, National Research Council, Canada, Vladimir.Pankov@nrc-cnrc.gc.ca

B2. CVD Coatings and Technologies

Session Chairs:
Raphaël Boichot, Université Grenoble Alpes, CNRS, France, raphael.boichot@simap.grenoble-inp.fr
Kazunori Koga, Kyushu University, Japan, koga@ed.kyushu-u.ac.jp

B3. Deposition Technologies and Applications for Carbon-based Coatings

Session Chairs:
Konrad Fadenberger, Robert Bosch GmbH, Germany, konrad.fadenberger@de.bosch.com
Mr. Frank Papa, GP Plasma, USA, frank@gpplasma.com

B4: Properties and Characterization of Hard Coatings and Surfaces

Session Chairs:
Naureen Ghafoor, Linköping Univ., IFM, Thin Film Physics Div., Sweden, naureen.ghafoor@liu.se
Marcus Günther, Robert Bosch GmbH, Germany, marcus.guenther2@de.bosch.com
Fan-Bean Wu, National United University, Taiwan, fbwu@nuu.edu.tw

B5: Hard and Multifunctional Nanostructured Coatings

Session Chairs:
Tomas Kozak, University of West Bohemia, Czechia, kozakt@ntis.zcu.cz
Rainer Hahn, Technische Universität Wien, Austria, rainer.hahn@tuwien.ac.at

B6: Coating Design and Architectures

Session Chairs:
Yin-Yu Chang, National Formosa University, Taiwan, yinyu@nfu.edu.tw
Paul Heinz Mayrhofer, Institute of Materials Science and Technology, TU Wien, Austria, paul.mayrhofer@tuwien.ac.at

B7: Plasma Surface Interactions, Diagnostics and Growth Processes

Session Chairs:
Arutun P. Ehiasarian, Sheffield Hallam University, UK, a.ehiasarian@shu.ac.uk
Yolanda Aranda Gonzalvo, University of Minnesota, USA, yarandag@umn.edu

B8: HiPIMS, Pulsed Plasmas and Energetic Deposition

Session Chairs:
Jon Tomas Gudmundsson, University of Iceland, tumi@hi.is
Tiberiu M. Minea, LPGP, Université Paris-Saclay, France, tiberiu.minea@u-psud.fr

SYMPOSIUM C: FUNCTIONAL THIN FILMS AND SURFACES

Symposium Chair: Peter Kelly, Manchester Metropolitan University, UK, peter.kelly@mmu.ac.uk

C1: Optical Materials and Thin Films

Session Chairs:
Nikolas Podraza, University of Toledo, USA, nikolas.podraza@utoledo.edu
Juan Antonio Zapien, City University of Hong Kong, apjazzs@cityu.edu.hk

C2: Thin Films for Electronic Devices

Session Chairs:
Julien Keraudy, Oerlikon Balzers, Oerlikon Surface Solutions AG, Liechtenstein, USA, julien.keraudy@oerlikon.com
Jörg Patscheider, Evatec AG, Switzerland, joerg.patscheider@evatecnet.com

C3: Thin Films for Energy Storage and Conversion

Session Chairs:

Clio Azina, RWTH Aachen, Germany,
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Tushar Shimpi, Colorado State Univ.,
USA, mechanical.tushar@gmail.com

C4: Photo- and Electrochemically Active Surfaces

Session Chairs:

Carlos Jose Tavares, Univ. of Minho,
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Glen West, Manchester Metropolitan
University, UK, g.west@mmu.ac.uk

SYMPOSIUM D: COATINGS FOR BIOMEDICAL AND HEALTHCARE APPLICATIONS

Symposium Chairs:

Jean G  ringer, Ecole des Mines de St-
Etienne - Universit   de Lyon, France,
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Jessica Amber Jennings, University of
Memphis, USA, jjennings@memphis.edu
Kerstin Thorwarth, Empa, Swiss Federal
Laboratories for Materials Science and
Technology, Switzerland,
kerstin.thorwarth@empa.ch

D1: Surface Coatings and Surface Modifications in Biological Environments

Session Chairs:

Mathew T. Mathew, University of Illinois
College of Medicine at Rockford and
Rush University Medical Center, USA,
mtmathew@uic.edu
Phaedra Silva-Bermudez, Instituto
Nacional de Rehabilitaci  n Luis
Guillermo Ibarra Ibarra, Mexico,
phaedrasilva@yahoo.com

D2: Medical Devices: Bio-Tribo-Corrosion, Diagnostics, 3D Printing

Session Chairs:

Steve Bull, Newcastle University, UK,
steve.bull@ncl.ac.uk
Hamdy Ibrahim, University of
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Margaret Stack, University of
Strathclyde, UK,
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D3: Biointerfaces: Improving Cell Adhesion and Avoiding Bacteria. What Kinds of Coatings Should be Used?

Session Chairs:

Sandra E. Rodil, Universidad Nacional
Aut  noma de M  xico, srodil@unam.mx
Danieli B.C. Rodrigues, Univ. of Texas at
Dallas, USA, danieli@utdallas.edu

SYMPOSIUM E: TRIBOLOGY AND MECHANICAL BEHAVIOR OF COATINGS AND ENGINEERED SURFACES

Symposium Chairs:

Carsten Gachot, Vienna University of
Technology, Austria,
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Giovanni Ramirez, Oxford Instruments,
USA, Giovanni.Ramirez@outlook.com

E1: Friction, Wear, Lubrication Effects, and Modeling

Session Chairs:

Oliver Hunold, Oerlikon Balzers,
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Manel Rodriguez Ripoll, AC2T Research
GmbH, Austria,
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Andreas Rosenkranz, Universidad de
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E2: Mechanical Properties and Adhesion

Session Chairs:

Jazmin Duarte, MPI f  r Eisenforschung
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Alice Lassnig, Austrian Acad. of Sciences,
Austria, alice.lassnig@oeaw.ac.at
Bo-Shiuan Li, Oxford University, UK, bo-
shiuan.li@materials.ox.ac.uk

E3: Coatings for Automotive and Aerospace Applications

Session Chairs:

Nazlim Bagcivan, Schaeffler Tech. GmbH
& Co. KG, Germany,
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Philipp Gr  tzmacher, Institute of Engin.
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SYMPOSIUM F: NEW HORIZONS IN COATINGS AND THIN FILMS

Symposium Chairs:

Diederik Depla, Ghent University, Belgium,
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Konrad Fadenberger, Robert Bosch
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F1: Nanomaterials and Nanofabrication

Session Chair:

Vitezslav Stranak, University of South
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F2: High Entropy and Other Multi-principal-element Materials

Session Chairs:

Erik Lewin, Uppsala University, Sweden,
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Jean-Francois Pierson, Institut Jean
Lamour-Universit   de Lorraine, France,
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F3: 2D Materials: Synthesis, Characterization, and Applications

Session Chairs:

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Deep Jariwala, Univ. of Pennsylvania,
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Suneel Kodambaka, University of
California Los Angeles, USA,
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F4: New Horizons in Boron-Containing Coatings

Session Chairs:

Marcus Hans, RWTH Aachen Univ.,
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Johanna Ros  n, Link  ping Univ.,
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F5: In-Silico Design of Novel Materials by Quantum Mechanics and Classical Methods

Session Chairs:

David Holec, Montanuniversit  t Leoben,
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Ivan Petrov, Univ. of Illinois at Urbana-
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SYMPOSIUM G: SURFACE ENGINEERING - APPLIED RESEARCH AND INDUSTRIAL APPLICATIONS

Symposium Chairs:

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G1: Advances in Application Driven Research: New Methods, Materials, and Equipment for PVD, CVD, and PECVD Processes

Session Chairs:

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G2: Surface Modification of Components in Automotive, Aerospace and Manufacturing Applications

Session Chairs:

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Hiroyuki Kousaka, Gifu Univ., Japan, kousaka@gifu-u.ac.jp

G3: Innovative Surface Engineering for Advanced Cutting and Forming Tool Applications

Session Chairs:

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Christoph Schiffers, CemeCon AG, Germany, christoph.schiffers@cemecon.de

G4: Hybrid Systems, Processes and Coatings

Session Chairs:

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SangYul Lee, Korea Aerospace University, Korea (Republic of), sylee@kau.ac.kr

SYMPOSIUM H: ADVANCED CHARACTERIZATION TECHNIQUES FOR COATINGS, THIN FILMS, AND SMALL VOLUMES

Symposium Chairs:

Benoit Merle, Friedrich-Alexander-University Erlangen-Nürnberg (FAU), Germany, benoit.merle@fau.de
Marco Sebastiani, University of Rome "Roma Tre," Italy, seba@uniroma3.it

H1: Spatially-resolved and In-Situ Characterization of Thin Films and Engineered Surfaces

Grégory Abadias, Institut Pprime - CNRS - ENSMA - Université de Poitiers, France, gregory.abadias@univ-poitiers.fr
Xavier Maeder, Empa, Swiss Federal Lab for Materials Science and Technology, Switzerland, xavier.maeder@empa.ch
Michael Tkadletz, Montanuniversität Leoben, Austria, michael.tkadletz@unileoben.ac.at

H2: Advanced Mechanical Testing of Surfaces, Thin Films, Coatings and Small Volumes

Session Chairs:

James Gibson, RWTH Aachen University, Germany, gibson@imm.rwth-aachen.de
Olivier Pierron, Georgia Institute of Technology, USA, olivier.pierron@me.gatech.edu

H3: Characterization of Coatings and Small Volumes in Harsh Environments

Session Chairs:

Thomas Edwards, Empa, Swiss Federal Laboratories for Materials Science and Technology, Thun, Switzerland, thomas.edwards@empa.ch
Peter Hosemann, University of California, Berkeley, USA, peterh@berkeley.edu

TOPICAL SYMPOSIA

TS1: Anti- and De-Icing Surface Engineering

Symposium Chairs:

Kevin Golovin, University of Toronto, Canada, kevin.golovin@utoronto.ca
Jolanta-Ewa Sapieha, École Polytechnique de Montréal, Canada, jolanta-ewa.sapieha@polymtl.ca

TS2: Thin Films on Polymer Substrates: Flexible Electronics and Beyond

Symposium Chairs:

Oleksandr Glushko, Montanuniversität Leoben, Leoben, Austria, oleksandr.glushko@unileoben.ac.at
Barbara Putz, Empa, Swiss Federal Lab for Materials Science and Technology, Switzerland, barbara.putz@empa.ch

TS3: Electrochemical Cells – Hydrogen and Batteries

Symposium Chairs:

Nazlim Bagcivan, Schaeffler Technologies GmbH & Co. KG, Germany, nazlim.bagcivan@schaeffler.com
Klaus Böbel, Bosch GmbH, Germany, klaus.boebel@de.bosch.com

TS4: Big Data, Machine Learning, Artificial Intelligence and High-Throughput Methods

Symposium Chairs:

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Samir Aouadi, University of North Texas, USA, samir.aouadi@unt.edu
Jochen Schneider, RWTH Aachen University, Germany, schneider@mch.rwth-aachen.de

TS5: Sustainable Surface Solutions, Materials, Processes and Applications

Symposium Chairs:

Fan-Yi Ouyang National Tsing Hua University, Taiwan, fyouyang@ess.nthu.edu.tw
Jörg Vetter, Oerlikon Balzers Coating Germany GmbH, joerg.vetter@oerlikon.com

TS6: A Session to Acknowledge the Contributions of Joe Greene to the ASED, ICMCTF, AVS, and IUUVSTA (ALL-INVITED SESSION)

Symposium Chairs:

Samir Aouadi, University of North Texas, USA, samir.aouadi@unt.edu
Ivan Petrov, University of Illinois at Urbana-Champaign, USA, petrov@illinois.edu
Michael Stüber, Karlsruhe Institute of Technology, Germany, michael.stueber@kit.edu

Coatings for Use at High Temperatures (A):

Symposium A addresses coatings and surface modifications whose primary purpose is to sustain system performance under high-temperature and harsh thermochemical environments. Topics of interest include high-temperature aging, stress, corrosion (e.g., oxidation, sulfidation, carburization, and water-accelerated degradation), catalytic and physical fouling (e.g., coking, ash fouling, and slagging) and wear (e.g., abrasion, erosion, and impact), characterization and mechanistic understanding of high-temperature degradation and mitigation technologies. Typical applications span gas/steam turbines, chemical/petrochemical processes as well as emerging renewable energy technologies, such as geothermal, biomass and concentrated solar power.

A1. Coatings to Resist High-temperature Oxidation, Corrosion, and Fouling

This session spans all aspects of the design, processing, and performance of coatings to resist high-temperature oxidation, corrosion, and fouling. Topics include composition and process optimization, characterization of coatings and reaction products, development of advanced processing methods such as additive manufacturing, modeling of fabrication processes and degradation mechanisms, lifetime prediction and performance assessment in realistic conditions (atmosphere, stress, cycling, erosion, etc.). Environments of interest include steam, SCO_2 , molten salts, liquid metal, hydrogen, ammonia, biofuels, etc. for applications such as turbomachinery, fuel cell and electrolyzers for green hydrogen production, concentrating solar power plants, advanced nuclear reactors, petrochemical and gasification plants, waste incinerators and metal-forming and recycling industries. Contributions addressing research as well as solutions are encouraged, with a focus on coatings and surface modification.

A1 Invited Speakers:

Alina Agüero Bruna, Instituto Nacional de Técnica Aeroespacial INTA, Spain, "Performance of Innovative High-Temperature Coatings after Exposure in a Pilot Plant Burning Biomass"

Denis Cumming, University of Sheffield, UK, "Controlling the Decomposition of Metal Salts to Enhance Nanostructured Solid Oxide Cell Electrode Performance and Reliability"

Suzue Yoneda, Hokkaido University, Japan, "Development of a New Coating Against High-Temperature Erosion-Corrosion in Fluidized Bed Biomass Boiler Condition"

A2. Thermal and Environmental Barrier Coatings

This session focuses on the design, development, synthesis, and applications of thermal and environmental barrier coatings for gas and high volume H_2 turbines and other high and ultra- high temperature applications. Topics include process understanding and novel processing methods, characterization of coating microstructure, properties (thermal, optical, mechanical, and chemical), testing methods (destructive and nondestructive), structure-property relationships, residual stresses, aging phenomena, substrate/coating system effects, and failure mechanisms, including CMAS attack, erosion, abrasion, and impact. These topics can be addressed for experimental research and/or modeling development.

A2 Invited Speakers:

Bryan Harder, NASA, USA, "Oxidation and Failure in Environmental Barrier Coatings"

Kenneth Kane, ORNL, USA, "Cristobalite Transformation in Environmental Barrier Coatings"

Elizabeth J. Opila, University of Virginia, USA, "Design of Multi-Component EBCs for Property Optimization"

Elisa Zaleski, Pratt & Whitney, USA, "Mechanisms of CMAS Attack on Aero-Engine Components"

AP: Coatings for Use at High Temperatures (Symposium A) Poster Session

Hard Coatings and Vapor Deposition Technologies (B):

Symposium B focuses on surface engineering and materials science of hard and protective coatings. We are interested in the fundamentals of deposition processes, properties of new single, multilayer, nanocomposite and nanostructured hard coatings, process-structure-property relationships, substrate effects, modeling, and industrial practices.

B1. PVD Coatings and Technologies

This session solicits contributions (except those covered by the topical sessions) related to sputter-deposition, cathodic and anodic arc discharges, laser ablation, electron beam (with and without additional ionization) and combinations of PVD coating methods. We welcome contributions on in-situ measurements, process modeling, plasma transport in electromagnetic fields, and multi-phase, gradient and nanostructured coatings, as well as hard and superhard coatings. Applications include but are not limited to wear-protective coatings for components and tools, low-friction thin films, high-temperature wear-, erosion-, and corrosion-resistant coatings, optical layers, biomaterials, decorative coatings, and materials for energy applications.

B1 Invited Speakers:

Thomas Arnold, Leibniz Institute of Surface Engineering (IOM), Germany, "Ultra-Precision Optical Surface Processing by Reactive Atmospheric Plasmas and Low Energy Ion Beams"

Andrey Voevodin, University of North Texas, USA, "Hybrid Technologies for Wear Protective Coatings With Adaptive Behavior"

B2. CVD Coatings and Technologies

This session solicits experts in thin films deposition techniques, involving chemical vapor deposition, for the growth of protective coatings and multifunctional, smart, or hard materials. This session will address (1) various techniques including Atmospheric Pressure CVD, LPCVD, MOCVD, ALD, HVPE, Pulsed CVD, and their plasma assisted counterparts, PECVD and PEALD; (2) novel molecular CVD precursors or original delivery systems for low vapor pressure/difficult precursors (DLI, pressure pulse, direct halogenation) ; (3) properties of materials and structures grown by these deposition techniques; and (4) CVD modeling techniques from molecular to equipment scale.

B2 Invited Speakers:

Takayuki Ohta, Meijo University, Japan, "Deposition of Hard Carbon Films by High Power Pulse Magnetron Sputtering"

Frédéric Schuster, CEA Saclay, France, "Chemical Vapor Deposition for Extreme Environments and Low Carbon Energies, an Integrated Approach from Lab to Fab"

B3. Deposition Technologies and Applications for Carbon-based Coatings

This session solicits contributions that address the application of carbon based coatings industry. We want to span the whole range from applications for DLC or ta-C on engineering components as well as coatings employed in devices and displays or electrochemical applications like fuel cells and electrolytic applications. Deposition technologies include plasma-based methods CVD, PVD, and their combination, arc, ion-beam, and laser-assisted deposition and HIPIMS as well as dip coating, sol-gel and other transfer techniques. This session includes fundamentals and development of interfaces between substrate and DLC to improve adhesion, supporting layers, and hybrids with hard coatings, industrial practices, scalability, and cost estimates.

B3 Invited Speakers:

Marcus Morstein, Hightech Zentrum Aargau AG, Switzerland, "Carbon-Based Coatings for Forming and Protection of Stainless Steel Sheets"

B4: Properties and Characterization of Hard Coatings and Surfaces

This session solicits contributions (except those covered by the topical sessions) on the relationships among composition, microstructure, and properties of hard coatings and surfaces, the effect of deposition parameters on these properties, as well as the development and use of novel characterization techniques.

B4 Invited Speakers:

Vinzenz Guski, IMWF, University of Stuttgart, Germany, "Microstructural Simulations on Thin Films"

Johan Nyman, Linköping University, Sweden, "Cathodic Arc Deposition of Chromium Based Coatings"

F.Y. Ouyang, National Tsing Hua University, Taiwan, "Thermal Stability of Nanotwinned Metallic Thin Films"

Da-Yung Wang, MingDao University, Taiwan, "Design and Characterization of Carbon-Based Coatings for Machining of Composite Materials"

B5: Hard and Multifunctional Nanostructured Coatings

This session solicits contributions related to nanostructured and nanocomposite coatings as well as multi-component and layered films with morphological designs adapting the microstructure down to the nanoscale level. The desired functionalities range from structural properties such as high hardness, toughness, or thermal stability to chemical inertness up to adaptive mechanisms like controlled friction as well as sensing properties. The session not only emphasizes the design and synthesis of novel coating concepts but also their characterization, modeling, and applications. In addition, combined functionalities such as in-situ sensing of structural coatings – just to mention one possibility – are highly appreciated to explore the next level of multifunctional and smart coatings.

B5 Invited Speakers:

Marcus Hans, RWTH Aachen, Germany, "Thermal Decomposition of Hard Coatings - Insights from Nanometer-Scale Characterization"

Efstathios Meletis, University of Texas at Arlington, USA, "Design of Coatings for Harsh Environments"

B6: Coating Design and Architectures

This session aims at bringing together computational and theoretical researchers and experimentalists in knowledge-based design and architectures of functional thin films and hard coatings. We are interested in both experimental and computational studies of knowledge-based chemical and structural design approaches. Studies on growth kinetics, prediction and explanation of structure and properties of surfaces, interfaces, and thin-film material systems as well as the thermodynamic processes involved are particularly welcome.

B6 Invited Speakers:

Jia-Hong Huang, National Tsing Hua University, Taiwan, "Effect of Coating Architecture on Stress Relief Mechanism of TiZrN Coatings on Si Substrate"

Mikula Marian, Comenius University, Slovakia, "Structural Design of Diboride Thin Films"

B7: Plasma Surface Interactions, Diagnostics and Growth Processes

Plasma processes are at the heart of inventive deposition strategies for innovative coating materials and nanostructures with enhanced properties and/or multiple functionalities. Diagnostics based on plasma composition and in surface characterization are essential to understand the physical properties of the coatings and mechanisms of the plasma growth processes and plasma-surface interaction. The objective of this session is to show how such correlations could establish processing-structure-property relationships and improve the design of materials. Talks featuring new plasma diagnostic techniques, characterization of plasmas in novel processes, correlation of intrinsic plasma properties to the structure and composition of materials and deployment of artificial intelligence/machine learning/big data methods to reveal the mechanisms of plasma generation, film growth and process quality assurance are welcome.

B7 Invited Speakers:

Ali Mesbah, University of California, Berkeley, USA, "The Promise of Data-Driven Methods for Diagnostics and Control of Plasma Interactions with Surfaces"

B8: HiPIMS, Pulsed Plasmas and Energetic Deposition

The energy carried to the thin film during deposition is crucial in reducing the growth temperature and improving the properties of thin film materials. Higher plasma density leads to enhanced ionization of the film precursors and offers better deposition process control. This results in improved coating characteristics, valuable e.g. optical, wear resistant, or photovoltaic applications. This session solicits contributions from academia as well as the industry which cover both the basic physics and the applications of energetic deposition. Topics of interest include but are not limited to: plasma generation and discharge physics, simulation and modelling, reactive processes and process control, mechanisms of film growth, surface and interface engineering, industrial applications and production, upscaling and associated equipment.

B8 Invited Speakers:

James W. Bradley, University of Liverpool, UK, "Diagnosing Bipolar HiPIMS Plasmas Using Laser Thomson Scattering"

Bocong Zheng, Fraunhofer USA Center Midwest, USA, "Kinetic Investigation of Electron Heating in HiPIMS Discharges"

BP: Hard Coatings and Vapor Deposition Technologies (Symposium B) Poster Session

FUNCTIONAL THIN FILMS AND SURFACES (C):

This Symposium focuses on surfaces, coatings and free standing architectures with specific surface functionalities. The content encompasses materials growth and structure; fundamentals of operation; design of novel materials; production, processing and integration into products and devices; and characterization of advanced functionality and sustainable development for a range of applications divided into the following sessions.

C1: Optical Materials and Thin Films

Current applications of optical materials, thin films, and advanced structured materials, impose extreme demands on their synthesis and performance. The optimization of these devices, from design to applications, can be facilitated by optical characterization methods such as spectrophotometry, ellipsometry, scatterometry, interferometry, vibrational spectroscopies, near-field microscopies and other light-matter interactions. We welcome contributions in the design, synthesis, characterization, and applications of thin films and nanostructures for optical applications.

C1 Invited Speakers:

Jeremy Munday, University of California at Davis, USA, "Nanophotonics Meets Quantum Technology for Clean Energy Devices"

Alberto Salleo, Stanford University, USA, "Fundamental Characterization of Non-Conventional Semiconducting Materials"

C2: Thin Films for Electronic Devices

This session is dedicated to functional thin films targeted for applications in active or passive thin film-based devices utilizing electronic, optical, magnetic, piezoelectric, and similar properties, and also addresses functional improvements using thin film coatings for electronic or semiconductor fabrication components. Material characteristics like electrical and thermal conductivity, optical and magnetic properties as well as thermal stability, oxidation, corrosion and wear resistance are considered. Application-related contributions are solicited addressing both experimental and theoretical studies on the design of film properties and processes to control growth, microstructure, phase changes, diffusion processes and oxidation protection, and corrosion and wear resistance aimed at a specific device or component performance.

C2 Invited Speakers:

W.W.M. Erwin Kessels, Eindhoven University of Technology, Netherlands, "Thermal and Plasma-Enhanced Atomic Layer Deposition for Nanoscale Coatings"

Thomas Ponnuswamy, Lam Research Corp., USA, "Advancements in Metallic Interconnects for the Semiconductor Industry"

Marcel A. Wall, Intel Corporation, USA, "Developing Electronic Materials With An Eye Towards Packaging"

C3: Thin Films for Energy Storage and Conversion

This session focuses on the materials science, physics, chemistry, and device engineering of thin films and nanostructures for energy conversion and storage applications. These include batteries, fuel cells, thermoelectrics, photovoltaics, as well as thermal energy and hydrogen storage solutions. The session will cover both theoretical and experimental work on the design, processing, and performance of novel material systems, which may include inorganic group IV, III-V, and II-VI semiconductors, organic semiconductors, oxides, nitrides and novel compounds of earth-abundant elements. We welcome contributions to recent developments in physical and chemical phenomena, processing of new materials, and novel device concepts in renewable energy technologies.

C3 Invited Speakers:

Maarit Karppinen, Aalto University, Finland, "Atomic/Molecular Layer Deposition (ALD/MLD) of Novel Layer-Engineered Inorganic-Organic Thin Film Materials for Emerging Energy Technologies"

Lane W. Martin, University of California, Berkeley, USA, "Designing Optimal Crystal and Electronic Structures for High Ionic Conductivity and Surface Catalytic Reactions"

C4: Photo- and Electrochemically Active Surfaces

This session focusses on materials design, production and characterization for a range of photochemical, electrochemical and photo-electrochemical surface functionalities; including, but not limited to photocatalysis, electrolysis, chemical and biological sensors, water splitting, battery technologies, supercapacitors, self-cleaning materials, antimicrobial surfaces, chemical synthesis, pollution remediation, and super-hydrophilic surfaces. Contributions relating to scientific fundamentals of the materials as well as applications-led content are welcome.

C4 Invited Speakers:

Valentim Barão, UNICAMP - University of Campinas, Brazil, "Shedding Light on Implant Biointerfaces: Designing Innovative Photocatalytic Coatings Towards Cell-Assisting and Bacteria-Killing Functions on Titanium"

Josef Krysa, University of Chemistry and Technology, Czechia, "Hematite and Titania Thin Films: Energy and Environmental Applications"

CP: Functional Thin Films and Surfaces (Symposium C) Poster Session

Coatings for Biomedical and Healthcare Applications (D):

This Symposium focuses on the synthesis, characterization, and performance (both in vitro and in vivo) of coatings and modified surfaces designed for biomedical applications (biomaterials, bioimplants, biosensors, general health care, etc.). The symposium will be devoted to creating a platform, a friendly hub, to promote some research discussions between material scientists, coating performers, and clinicians. Papers are solicited in areas related to: bioactive and biocompatible coatings for implants (orthopedic, dental, spinal, etc.), cardio-vascular stents, drug delivery and biosensing; hydroxyapatite coatings; biomimetic and bio-inspired coatings; anti-bacterial, anti-biofouling and eluting coatings; blood-compatible coatings; electrospun coatings; biofunctionalization of materials surfaces such as tissue engineering scaffolds by wet chemical and plasma methods; cell-surface interactions; bio-lubrication and bio-tribology; and processing and characterization of biomaterial surfaces. Concerning the interactions between the coating and the medium, some investigations were dedicated to studying the corrosion degradation of the substrate. Moreover, some opening fields are focused on the effect of the coating on the biological behavior, as cells growth, cells adhesion, etc. Some contributions in the fields of retrieval implant analysis, the release of metal ions/particles, smart/intelligent surfaces and potential clinical concerns will be also considered. A new key

interest is 3D printing. Additive manufacturing requires most of the time some surface coatings to promote osseointegration and more generally biocompatibility. The D Symposium will have a look at this new area.

D1: Surface Coatings and Surface Modifications in Biological Environments

This session is dedicated to coatings as well as surface modifications for use in biomedical applications in order to improve performance characteristics or to add additional functions to an implant or surgical instrument. The functionalities of these coatings/surface modifications should focus on the improvement of one or more attributes such as biocompatibility, cell proliferation and growth, suppression of restenosis, thrombus formation, antimicrobial behavior and metallic ion release, load-bearing prostheses, corrosion resistance, wear resistance, etc. under in vitro and in vivo conditions.

D1 Invited Speakers:

Mozart Q. Neto, Rush University Medical Center, USA, "Microstructural and Electrochemical Characterization of 3D Printed Biomedical Implants"

Rene Olivares-Navarrete, Virginia Commonwealth University, USA, "Surface Properties Control Immune Response to Implanted Biomaterials"

D2: Medical Devices: Bio-Tribo-Corrosion, Diagnostics, 3D Printing

Metallurgical materials are essential components of medical devices used to restore biological function, detect or respond to physiological or external stimuli, or modulate the response of cells at interfaces. This session seeks to explore clinical applications and physiological responses to material systems used for tissue regeneration, implantable sensors, and smart drug delivery, among others. Fabrication and testing of these materials using additive manufacturing technologies are of particular interest. Research is solicited that evaluates biological reactions to implant surface coatings as well as methods of depositing coating particles of varying size and composition. Release of molecules or particles from surfaces, either intentionally or due to wear and corrosion processes is also an area of interest.

D2 Invited Speakers:

D3: Biointerfaces: Improving Cell Adhesion and Avoiding Bacteria. What Kinds of Coatings Should be Used?

What Kinds of Coatings Should be Used? Interaction between cells and biomaterials occurs via the surface characteristics of the material, which include their topography, chemistry, mechanical properties or surface energy. These interactions trigger desired or undesired processes. For example, they can induce signaling pathways to regulate cell adhesion, migration, proliferation and differentiation into specific phenotypes desirable for the application. However, they might also promote excessive adhesion of microorganisms forming biofilms that can lead to significant health risks. Such interactions are greatly determined by the initial protein adsorption that occurs in a shorter time scale. Understanding all these interaction processes and their correlation with the surface properties is key knowledge that will allow us to design novel surfaces or coatings to promote specific biological responses, i.e. design bioactive surfaces.

D3 Invited Speakers:

Sami Rtimi, Ibticare Group, Switzerland, "Catalytic Reactions at the Interface Thin Film/Bacteria: Dynamics, Characterization and Mechanisms"

DP: Coatings for Biomedical and Healthcare Applications (Symposium D) Poster Session

Tribology and Mechanical Behavior of Coatings and Engineered Surfaces (E):

This symposium covers all aspects of tribology, mechanical properties, and adhesion of coatings and engineered surfaces. The scope includes both experimental investigations and modeling of static (e.g., indentation and adhesion) and dynamic (e.g., oscillating, scratching, sliding, and rolling) contacts, and contact/fracture mechanics from atomistic to macroscopic length scales. We welcome contributions that improve scientific and mechanistic understanding of tribo-mechanical responses, characterization and performance of engineered surfaces and coatings, processing-structure-property-performance relationships, design of coatings for specific applications, and size effects. Additional emphasis is given to multifunctional (hard and lubricious) and nanocomposite coatings for extreme environments, nanostructured coatings, diamond and diamond-like carbon, and coatings for advanced aerospace, automotive, and machining applications, along with advances in instrumentation and measurement techniques.

E1: Friction, Wear, Lubrication Effects, and Modeling

This session covers all phenomena related to friction, wear, lubrication, and modeling. We solicit contributions on the development, characterization and modeling of materials, coatings or innovative structures to control friction and wear, including liquid and solid lubrication. We are interested in studies providing a new understanding of tribological mechanisms of coatings and thin films. Emphasis will be given to contributions on understanding the role of coating composition and structure in friction and wear reduction. The incorporation of additional coating functionalities (thermal cycling resistance, fracture toughness, oxidation resistance, etc.) is also an important issue.

Contributions on theoretical and computational modeling of tribological interactions at the atomic or molecular level are also welcome.

E1 Invited Speakers:

Babak Anasori, Purdue University, USA, "2D Transition Metal Carbide MXenes: Their Synthesis, Tunable Compositions and Mechanical Properties"

Diana Berman, University of North Texas, USA, "Nanoscale Materials for Macroscale Applications: Zero-Friction and Zero-Wear Carbon Films"

Giovanni Bolelli, Unimore, Italy, "Critical Materials-Free Cermet Coatings by Thermal Spraying: Sliding and Abrasive Wear Behaviour"

Michael Chandross, Sandia National Laboratories, USA, "Grain Boundary Sliding and Low Friction in Metal Contacts"

E2: Mechanical Properties and Adhesion

This session is devoted to the measurement and modeling of the mechanical properties of surface and near-surface regions of thin films, coatings, and surface-engineered bulk materials. We are interested in measurement methods and models for the quantitative determination of mechanical properties, residual stresses, interface adhesion, fatigue, and fracture toughness. Emphasis will be given to contributions on novel test methods, such as in situ testing in SEM or TEM, multi-axial contact mechanics, MEMS testbeds, and new approaches for the extraction of mechanical and constitutive properties by modeling of indentation load-displacement curves. Finally, special consideration will be given to contributions that address processing-structure- mechanical property relationships across multiple length scales.

E2 Invited Speakers:

Golta Khatibi, TU Wien, Austria, "Reliability Assessment of Thin Films and Multilayers in Electronic Packages"

Maria Clelia Righi, University of Bologna, Italy

E3: Coatings for Automotive and Aerospace Applications

Surface engineering and advanced coatings contribute to improved durability and fuel efficiency in transportation. This session welcomes contributions on the development, characterization, and mechanical as well as tribological evaluation of coating solutions and surface functionalization in automotive and aerospace engineering applications. Thin film coatings, diffusion treatments as well other types of coatings are welcome. Special consideration will be given to contributions that address overarching investigations to link fundamental insights with application results.

E3 Invited Speakers:

Arđian Morina, University of Leeds, UK, "In-situ Coating Wear Measurement: Impact of Lubricant Chemistry"

Matthias Scherge, Fraunhofer Institute for Mechanics of Materials IWM, Germany, "Running-in of DLC and Its Nanoscale Footprint"

EP: Tribology and Mechanical Behavior of Coatings and Engineered Surfaces (Symposium E) Poster Session

New Horizons in Coatings and Thin Films (F):

This cross-cutting symposium aims at expanding the scope of the conference by encouraging hot topics that are new to ICMCTF. The five sessions of the symposium will provide a forum for new pioneering topics including the latest advances in computational material science, the synthesis of nanomaterials and nanofabrication, and coatings based on multi-principal-element and 2D materials.

F1: Nanomaterials and Nanofabrication

This session focuses on harnessing nanoscale phenomena and innovative deposition strategies for new types of nanostructures and nanomaterial coatings with multiple functionalities. Advances in thin films, nanocrystals, nanoparticles, nanowires, nanotubes, and their applications will be addressed, as well as the development and application of novel in-situ diagnostics to understand and control these growth processes. Further areas of interest include emerging direct-write, cluster-beam, and bio-inspired deposition methods, theoretical and computational research in nanomaterials with controlled properties, processing-structure-property relationships, novel application concepts or prototypes using nano-engineered structures, and plasma fundamentals and diagnostics. These topics cover the understanding and synthesis of novel nanostructured materials and how to apply them in the next-generation nano-devices, and the development of innovative manufacturing processes.

F1 Invited Speakers:

Vladimir Popok, Aalborg University, Denmark, "Polymer Films with Gas-Phase Aggregated Nanoparticles: Formation and Applications"

F2: High Entropy and Other Multi-principal-element Materials

High entropy alloys (HEAs) and other multi-principal-element materials are multicomponent systems in which high entropy of mixing, or kinetic effects, stabilize a solid solution. They exhibit unique chemical and physical properties and have therefore recently attracted a growing interest in the materials science community. This session will be a platform for thin film-related research on high entropy and multi-principal-element materials including metal alloys, carbides, nitrides, and oxides as well as other multicomponent systems in which high entropy affects phase stability. Topics of interest include, but are not limited to, modeling, thin film processing, and characterizations of HEAs and other multi-principal-element materials.

F2 Invited Speakers:

Alexander Pogrebnjak, Sumy State University, Ukraine, "Design, Structure and Properties of Nanolayer Nitrides of High-Entropy Alloys"

F3: 2D Materials: Synthesis, Characterization, and Applications

This session focuses on exciting developments in the field of 2D materials, including but not limited to graphene, transition metal dichalcogenides (MoS₂, WS₂, etc.), BN, oxides, as well as emerging 2D carbides and nitrides. 2D materials have been extensively researched in the last decade as atomically-thin metal, semiconductor, and insulator materials with novel and extraordinary properties. Recent advances in their synthesis have provided new possibilities to tune their structure, properties, and enhance their electrical, mechanical, lubrication, and anticorrosion performances. Researchers working in the field of 2D material synthesis and processing, characterization, and applications are encouraged to submit abstracts. We seek to advance the research and development of 2D material-based coatings by connecting researchers from diverse academic and industrial backgrounds, including tribology, materials science, physics, and chemistry. Topics include: controlled scalable synthesis of 2D materials, composite materials and heterostructures, mixed 2D phases and alloys, formation and control of defects, grain boundaries, edges, interfaces, nanopores, characterization, theoretical modeling, device fabrication, post-synthesis engineering of 2D materials using chemical treatments and ion/electron beams, and applications of 2D materials in electronics, sensing, coating, friction/wear reduction, anti-corrosion, and anti-fouling.

F3 Invited Speakers:

Nicholas Glavin, Air Force Research Laboratory, USA, "Synthesis and Characterization of Two Dimensional Chalcogenide Semiconductors and their Heterostructures"

F4: New Horizons in Boron-Containing Coatings

Borides and boron-containing thin film materials are emerging as the next generation of hard, wear-, oxidation-, and corrosion-resistant coatings. Furthermore, various boron-based materials exhibit unique properties obtaining high potential for functional and architectural materials design. The aim of this session is to provide a platform for discussions on first-principles design, synthesis, characterization, properties and applications of different types of boron-containing protective and functional thin films. A particular focus is directed towards synthesis technologies, including both PVD and CVD, but also theoretical modeling and advanced characterization techniques.

F4 Invited Speakers:

Justinas Palisaitis, Linköping University, Sweden, "Revealing the Beauty of Imperfection in Novel Diboride Coatings by Transmission Electron Microscopy"

Daniel Primetzhofer, Uppsala University, Sweden, "Accurate Composition Depth Profiling of Light Elements in Thin Films Using Ion Beams - What Can Be Achieved?"

Pavel Souček, Masaryk University, Czechia, "Mapping the X-B-C Systems: Search for the Elusive X₂BC Phase"

Michael Stüber, Karlsruhe Institute of Technology (KIT), Germany, "PVD Diboride-Based Thin Films - New Concepts for Materials Design: From Alloys to Composites and Multilayers"

Sarah Tolbert, University of California, Los Angeles, USA, "Superhard Metal Borides"

F5: In-Silico Design of Novel Materials by Quantum Mechanics and Classical Methods

With increasingly complex materials being synthesized for an ever-growing range of applications, there is a great need for understanding material properties at the atomistic and electronic levels. To this end, quantum mechanical and classical methods are incredibly powerful tools capable of guiding the entire design process. Tremendous improvements in computational resources, coupled with software development in recent years, make it possible to calculate real materials properties and thus provide a roadmap for experimental materials synthesis. This Symposium will cover a range of computational methodologies employed in materials design, incorporating fundamental first-principles calculations probing structure-property relationships, density-functional ab initio molecular dynamics (AIMD) simulations at finite temperatures that allow us to identify atomistic processes and associated changes in electronic structure which control strength, plasticity, and fracture in materials, through to large-scale 'virtual experiments' tackled using a classical Molecular Dynamics approach. Contributions employing

machine learning and big data approach are particularly welcome to complement the more traditional atomistic methods. This session will bring together world experts in computational materials science with the broad community of thin film and coating growers within ICMCTF. It will highlight representative examples of data-driven materials design, which span from theoretical prediction to experimental validation via synthesis, characterization, and testing, showcasing rapid iteration between ideas, computations, insight and new materials development.

F5 Invited Speakers:

- Cheng Jianli*, Lawrence Berkeley Laboratory, USA, "Computational Screening of Amorphous Cathode Coatings for High-Voltage Li-ion Battery Applications"
- Prashanth Srinivasan*, University of Stuttgart, Germany, "Machine Learning Assisted Ab Initio Thermodynamics of Novel Materials"
- Davide Sangiovanni*, Linköping University, Sweden, "Atomistic Understanding of Plasticity at Crack Tips in Refractory Ceramics"
- Susan Sinnott*, The Pennsylvania State University, USA, "Advancing Computational Methods for Heterogeneous Material Systems"

FP: New Horizons in Coatings and Thin Films (Symposium F) Poster Session

Surface Engineering - Applied Research and Industrial Applications (G):

This symposium is jointly organized by ICMCTF (AVS/ASED) and the Society of Vacuum Coaters (SVC) and will focus on applied research related to industrial manufacturing and application aspects of various surface engineering and coating technologies. Topics include recent advancements in surface engineering equipment and the application of PVD/CVD deposition technologies for coatings and thin films in automotive, aerospace, component and tooling/cutting applications. Also of particular interest are surface treatments before and after the coating processes to enhance the performance of engineered surfaces, hybrid/duplex coating techniques, innovations in manufacturing practices, and cooperation between industry, research organizations, and academia to advance surface engineering applications.

G1: Advances in Application Driven Research: New Methods, Materials, and Equipment for PVD, CVD, and PECVD Processes

The scope of this session is on the research results produced in cooperation between industry, research laboratories, and academia. One focus should be on companies that can present current status and achievements, as well as to address future development trends. Academic institutions are highly encouraged to present results of background research or contributions aimed at the development of the tailored solutions to meet the industrial demands of thin film and hard coatings applications.

G1 Invited Speakers:

- Mark Bernick*, Angstrom Sciences, USA, "New Developments in Magnetron Sputtering Systems"
- Vishal Khetan*, Oerlikon Balzers, Liechtenstein, "Carbon-Based Surface Solutions for High Performance Forming Tools - A Journey from Material Research to Industrial Solutions"

G2: Surface Modification of Components in Automotive, Aerospace and Manufacturing Applications

This session will cover application-oriented research and development on surface-modified products and technologies. Topics include surface modified or coated products/components in the area of tribology, corrosion, high temperature, optical, magnetic and allied technologies. The focus is also on novel substrate preparation and pre-treatment methods: substrate nitriding, carburizing, boriding, or oxidation pre-treatments; intermediate etching treatment and interlayer design during the coating processes; coating post-treatments, including laser, electron beam, annealing, ion implantation or mechanical/chemical/optical techniques, and integrated and/or novel treatments and process combinations. The main criteria are that the surface modification/coatings should be applied to semi/end products to enable/improve desired physical/chemical properties. The components used in automotive, aerospace, manufacturing, land-based and aero turbines, mining, oil drilling and fracking, construction machinery and farming equipment are of primary interest in this session. Papers dealing with aspects relating to properties, processes, performance, equipment and industrial applications for such treatments are all welcome.

G2 Invited Speakers:

- Chris Berndt*, Australian Research Council, Industrial Transformation Training Centre, Australia, "Surface Engineering Opportunities: Harsh Environments Meeting New Strategies for Microstructural Designs"
- Manuel Mee*, Oerlikon Balzers, Germany, "Plasma Nitriding of Forming Tools for the Automotive Industry - Challenges and Opportunities"
- Jens Wartmann*, ZBT GmbH, Germany, "Importance of Thin Films and Coatings for the Green Hydrogen Economy"

G3: Innovative Surface Engineering for Advanced Cutting and Forming Tool Applications

The requirements of manufacturing industries and recent innovative developments in coatings and surface engineering processes for advanced tooling applications are the focus of this session. Such applications include but are not limited to high-demanding sheet or bulk metal forming, plastics processing, die-casting as well as cutting operations of steel, cast iron and difficult-to-cut materials like high-temperature alloys or CFRP. Novelties related to the use of coating technologies like PVD arc, sputtering, HIPIMS, hybrid, electron beam as well as PECVD and CVD for application-oriented design of different coating materials, architectures and properties are welcome. Insights into the combined effect of tool geometry and adapted coatings are also in the focus of the present session. Furthermore, contributions highlighting the interaction of the coatings designed for cutting and forming applications with the ambient atmosphere and/or the counterpart materials including metallic alloys and polymers are within the focus of this session.

G3 Invited Speakers:

Ricardo Alexandre, TEandM, Portugal, "Coating Design for Components for Extreme Applications"

Carles Colominas, IQS School of Engineering, Materials Engineering Group (GEMAT), Spain, "Bringing Together Research, Job Coating and Market Needs"

G4: Hybrid Systems, Processes and Coatings

This session focuses on novel methods that employ combinations of several processes and systems during film deposition. Hybrid systems can combine different ionization sources, like lasers, hot filaments, hollow cathodes, electron- or ion-guns, etc. with conventional magnetrons or arc evaporators, to provide increased ionization, additional heating of the substrate, or to change the distribution of plasma density in the reactor. Hybrid systems can also combine different gas pressures, including atmospheric plasma activation, can use pulsed gas inflows synchronized with pulsed power, pulsed biasing, etc. Hybrid processes can integrate different mechanisms of production of species for film deposition, for example, PVD with PE CVD. Contributions on organic-inorganic hybrid coatings and hybrid processes both at reduced and atmospheric pressures are also solicited.

G4 Invited Speakers:

Jiri Vyskocil, HVM Plasma, Prague, Czechia, "Hybrid HIPIMS and Controlled Pulsed Arc for Deposition of Hard Coatings"

GP: Surface Engineering - Applied Research and Industrial Applications (Symposium G) Poster Session

Advanced Characterization Techniques for Coatings, Thin Films, and Small Volumes (H):

This Symposium focuses on recent advances in the structural, microstructural, and mechanical characterization of coatings and thin films, which enhance our understanding of the growth and surface modification processes as well as the fundamental structure-property-processing relationships. Of interest are contributions that either highlight the application of, or draw attention to, recent advances in analytical methods, characterization techniques, and novel nano-mechanical testing methods for coating evaluation. Analytical methods may include numerical evaluation and quantification procedures (e.g., factor analysis, depth profiling, 3D mapping, etc.) to reveal the micro- and nano-structure, chemical composition, residual stress, chemical states, and phases of coatings, thin films, interfaces, and surfaces during or after surface modification. Micro- and nanomechanical methods may include compression, bending, or toughness testing to determine coating behavior, particularly at elevated/service temperatures and in harsh environments, and the relationship to coating performance and lifetime. Residual stress analysis, phase characterization, surface topography probes, compositional analysis, high-resolution spatial imaging and analysis, and hardness measurements continue to be subjects of interest in the sessions. In-situ characterization methods and other novel techniques presenting the combination between microstructural nano-mechanical probes are highly encouraged.

H1: Spatially-resolved and In-Situ Characterization of Thin Films and Engineered Surfaces

In this session all aspects concerning novel spatially-resolved structural, microstructural and chemical characterization techniques, especially those that advance the in-depth understanding of the relationship between the processing, the structure and the properties of thin films and engineered surfaces. Particular attention will be given to papers providing information on novel cutting-edge experiments on the analysis of the microstructure and microstructural evolution of thin films, including in-situ measurements during film growth, spatially resolved analysis of residual stress and three-dimensional chemical mapping. Emphasis will be given to novel high-resolution techniques, such as Atom Probe Tomography, X-ray nano-diffraction, advanced TEM characterization, micro-Raman spectroscopy, etc. Papers are furthermore also solicited in the emerging area of three-dimensional microstructural characterization in small volumes, such as FIB/SEM tomography, in-situ EBSD and/or ToF-SIMS 3D mapping.

H1 Invited Speakers:

Yolita Eggeler, Karlsruhe Institute of Technology (KIT), Germany, "In situ TEM Microscopy for Revealing Small Scale Materials Mechanisms"

Andrew Minor, University of California, Berkeley, USA, "In Situ Observations and Measurements of Plastic Deformation, Phase Transformations and Fracture With 4D-STEM"

H2: Advanced Mechanical Testing of Surfaces, Thin Films, Coatings and Small Volumes

This session covers advanced mechanical characterization techniques for surfaces, thin films and coatings with a focus on the development of novel methods rather than the application of standard methods to new materials. This includes novel methods of performing nanoindentation testing or analysis methods and testing of micro-scale testing geometries produced using focused ion beam (FIB) machining or issues related to the FIB-machined structures. Particular attention will be given to papers providing details on developing techniques such as novel fracture testing geometries. Emphasis will be given to testing techniques performed in situ in the SEM, TEM, Raman, X-ray beamline, etc. Papers are also solicited in the emerging area of nano- or micro-testing at high strain rates.

H2 Invited Speakers:

Jens Bauer, University of California, Irvine, USA, "Tensegrity Metamaterials - Towards Failure Resistant Engineering Systems"

Ralph Spolenak, ETH Zürich, Switzerland, "Optical Analysis by Local and Global Reflectance Anisotropy Spectroscopy: Nanomechanics, Topography and Crystal Orientation"

H3: Characterization of Coatings and Small Volumes in Harsh Environments

This session covers the characterization of the coatings microstructure and mechanical behavior under harsh and/or unusual conditions, such as high or cryogenic temperatures, radiation, hydrogen embrittlement and high strain rates. Particular attention will be given to papers providing characterization in-situ in the harsh environment, rather than ex-situ after exposure: e.g. nanoindentation testing performed at high temperatures rather than after an annealing treatment in a separate furnace. Emphasis will be given to work that shows progress pushing the testing envelope further into harsher environments or combining multiple characterization techniques to gain information on coatings' behavior under severe or aggressive environments.

H3 Invited Speakers:

Brad Boyce, Sandia National Laboratories, USA, "In-situ Characterization of Nanocrystalline Pt-Au Thin Films in Thermal, Mechanical, and Irradiation Environments"

HP: Advanced Characterization Techniques for Coatings, Thin Films, and Small Volumes (Symposium H) Poster Session

TOPICAL SYMPOSIA (TS): Six topical symposia will address emerging areas in surface engineering:

TS1: Anti- and De-Icing Surface Engineering

Ice accretion constitutes a severe issue for several sectors, including aeronautics, maritime, power transmission, wind turbines, off-shore oil platforms and construction, among others. It hinders operation and reduces efficiency posing significant economical and safety concerns, sometimes with catastrophic consequences. Extensive effort has been devoted to tackling this crucial yet challenging issue. Different ice protection technologies are presently in use, still, most of them have inherent bad effects such as high energy consumption, increased weight, a negative environmental impact, and the need for frequent reapplication. Surface engineering can provide a better alternative by reducing or eliminating ice accumulation on one hand and the other can contribute to simplifying the current de-icing systems by facilitating ice detachment once it is formed. Engineering the surface chemistry, surface texture, or mechanical properties of the surface have shown promise, and limitations. Accordingly, there is a lack of consensus in the scientific community about the best surface engineering strategy for tackling the ice accretion problem. For many industries, mechanical resilience and long-term performance requirements are additional constraints requiring cutting-edge research and a greater understanding of ice-surface interactions. This topical symposium aims to bring together the growing number of researchers working in this field employing different strategies, materials and methods in an attempt to reduce ice accretion by surface engineering, while at the same time trying to gain a better understanding of ice growth, accretion, adhesion, and detachment mechanisms.

TS1 Invited Speakers:

Hadi Ghasemi, University of Houston, USA, "On Nanoscale Physics of Ice Shedding Coatings"

Anne Kietzig, McGill University, Canada, "Penguin-Inspired Anti-Icing Surfaces"

TS1P: Anti- and De-Icing Surface Engineering - TS1 Poster Session

TS2: Thin Films on Polymer Substrates: Flexible Electronics and Beyond

This session focuses on all aspects of material science related to thin films and coatings deposited on polymer substrates as well as metal-polymer and ceramic-polymer composite materials in general. Both fundamental and applied contributions on the following topics are highly welcome: Thin films for flexible electronics applications (conductive, semiconducting, magnetic, barrier layers, encapsulation, etc.), Additive manufacturing and other novel methods for thin film fabrication, Atomic Layer (ALD) and Molecular Layer Deposition (MLD), Fabrication and properties of metal-polymer/ceramic-polymer composites and interfaces, 3D printing of metal-polymer

composites, Functional and mechanical properties of novel alloys deposited on polymer substrates (high-entropy alloys, metallic glasses, etc.), and Flexible and stretchable electronic devices.

TS2 Invited Speakers:

Patric Gruber, KIT Karlsruhe, Germany, "Electromechanical Behavior of Evaporated and Printed Thin Films and Devices on Compliant Substrates"

Peter Zalar, Holst Centre / TNO, Netherlands, "Development and Application of Screen-Printed Large-Area Sensing Surfaces"

TS2P: Thin Films on Polymer Substrates: Flexible Electronics and Beyond - TS2 Poster Session

TS3: Electrochemical Cells – Hydrogen and Batteries

The future of energy is driven by the overall goal to provide green and sustainable energy for all industrial sectors. All mobile and stationary applications will be affected by these changes. The achievement of these goals relies on green and sustainable energy generation but also on the ability to store this energy. Once electricity is generated with regenerative technologies it can be stored in batteries or transported using Hydrogen as a carrier to its final destination and transferred to electricity again when needed. Electrochemical cells are key elements in Hydrogen production and storage of generated electricity in batteries. Surface coatings and surface functionalization in these cells are providing key properties to enable and drive necessary reactions. Electrode surfaces must provide high electric conductivities and withstand harsh electrochemically corrosive environments. On the other hand, membrane assemblies must be functionalized and act as carriers for catalysts. In solid-state batteries coatings are needed for interface design between electrodes and electrolytes. Moreover, coating processes are needed for the application of active materials. Future technical and economic success in Hydrogen generation and electricity storage is mainly driven by the developments related to these electrochemical cells. This topical symposium focuses on coatings and surface functionalization in electrochemical cells used in Hydrogen applications, e.g. electrolysis, fuel cells, and in electricity storage, e.g. Li-batteries, solid state batteries, flow batteries.

TS3 Invited Speakers:

Etienne Bouyer, Commissariat à l'Energie Atomique et aux Energies Alternatives (CEA), France, "Coatings for Fuel Cells and Electrolyzers: From Materials to Processes, Challenges and Opportunities"

Özge Kahvecioglu, Argonne National Laboratory, USA, "Current and Future Trends in Materials for Advanced Lithium Batteries"

TS3P: Electrochemical Cells – Hydrogen and Batteries - TS3 Poster Session

TS4: Big Data, Machine Learning, Artificial Intelligence and High-Throughput Methods

An exponential growth of computational power and storage density, combined with progress in data science, have brought the information revolution. Data-driven methods are now in ubiquitous use in multiple fields, including life sciences and medicine, economics, social networks, etc. A visionary suggestion of integrating materials development with data-driven methods, materials informatics, is bringing a disruptive paradigm shift in materials science. The framework has the potential to reduce dramatically cost, risks and time for materials discoveries, by an order of magnitude or more. It is capable to produce qualitatively new insights, beyond the reach of conventional research techniques. This topical session will focus on presenting machine learning, artificial intelligence, visualization algorithms and high-throughput methods, as well as best practices of their applications for the knowledge-based materials design. Challenges related to the generation, curation and exploration of big materials data from a wide range of sources, theoretical, as well as experimental will be discussed. The topical session will bring together the broad community of researchers in metallurgical coatings and thin films with leading experts and young researchers developing and applying data-driven methods in materials science.

TS4 Invited Speakers:

Jakoah Brgoch, University of Houston, USA, "Finding Thermally Robust Superhard Materials with Machine Learning"

Johanna Rosén, Linköping University, Sweden, "New 3D and 2D Metal Borides from Materials Synthesis Guided by High-Throughput Simulations"

Kenneth S. Vecchio, University of California San Diego, USA, "High Throughput Approaches for Designing Bulk Materials"

TS4P: Big Data, Machine Learning, Artificial Intelligence and High-Throughput Methods - TS4 Poster Session

TS5. Sustainable Surface Solutions, Materials, Processes and Applications

The symposium on sustainable surface solutions is intended for engineers and scientists working in all fields between fundamental research and product development by surface modification processes. The full scope of surface modifications like chemical or physical processing, material deposition or removal in dimensions of nanometers to some hundred microns shall be considered to generate functional surfaces. The focus is on the complete range from process and materials to applications with the goal to minimize or even to eliminate negative environmental impact, and perhaps also to improve environmental conditions. Surface solutions have the potential to enable sustainable solutions for functionalized and even smart surfaces, but surface solutions in itself should also be sustainable. Innovative ideas for new pathways to generate sustainable surface functions are welcome. The surface modification process in general or, as an example, a coating deposition process has to be designed for sustainability including the adequately targeted durability, the effort and waste for production and the recyclability at the end of life. This includes an assessment of the total GHG (greenhouse gas) impact and the release of harmful substances. Impact measure for the total carbon footprint for any resource to adjust surface properties are increasingly of importance due to national and international regulations. This includes aspects of material selection, utilization and energy efficiency. Life cycle assessment (cradle to grave) aspects are of interest beginning with the material selection ending with the “recycling” (circular economy, cradle to cradle). Selected keys are as follows: Tailored components of the deposition (treatment) equipment’s (PVD, CVD; Spraying, Nitriding and others) and the processes themselves are steps to achieve a progress in sustainability, e.g. to reduce energy consumption and pollutions; Low-impact materials (non-toxic, recycled materials) both for the surface and for intermediate steps are of special interest; Sustainable Surface Solutions should not be reduced to wear and/or friction reduction. Pathways of sustainable solutions based on various deposition (treatment) processes for energy conversion and storage (e.g. wind power, batteries, supercaps, hydrogen storage, thermal insulation), self-cleaning surfaces (e.g. photocatalytic effect, lotus effect), coatings on plastics, optical coatings, medical coatings, decorative coatings, antifouling coatings, corrosion protection coatings, sensoric and electronic coatings shall be highlighted.

TS5 Invited Speakers:

Frederic Schuster, Centre d'Etudes de Saclay Atomic Energy and Alternative Energies Commission, France,
“Innovative Processes for High Performance Materials for Low Carbon Energy in a Circular Economy Approach”
Jr-Hau He, City University of Hong Kong, “Solar Fuels: Photoelectrochemical Hydrogen Generation and CO₂ and NH₃ Reduction”

TS6: A Session to Acknowledge the Contributions of Joe Greene to the ASED, ICMCTF, AVS, and IUVESTA (ALL-INVITED SESSION)

This session is in honor of Prof. Joe Greene. Everyone associated with the ASED, ICMCTF, AVS and IUVESTA will recognize the enormous contributions of Joe Greene to science and technology of interest to these communities, his leadership of the organizations, and his mentorship of his colleagues and students. The session is comprised of invited talks reflecting on Joe’s impact and resulting contributions from only a few of the many lives and research careers Joe has affected. Joe Greene is the D.B. Willett Professor of Materials Science at the University of Illinois, the Tage Erlander Professor of Materials Physics at Linköping University, Sweden, and a Chaired Professor at the National Taiwan University of Science and Technology in Taipei. Joe is still recovering from a serious stroke experienced at the AVS fall meeting in late October 2019.

TS6 Invited Speakers:

Scott Barnett, Northwestern University, USA, “From Thin Films to Solid Oxide Fuel Cells”
Jinn P. Chu, National Taiwan University of Science and Technology, Taiwan, “Metallic Glass Coating: Unique Properties and Its Non-stick Application”
Diederik Depla, Ghent University, Belgium
Yonglim Foo, Singapore Institute of Technology, Singapore
Glenn Glass, Intel Corporation, USA, “Predictive Kinetics-based Epitaxial Film Growth Modeling for the SiGe, Si:B and SiGe:B Systems”
Grzegorz (Greg) Greczynski, Linköping University, Sweden
Lars Hultman, Linköping University, Sweden
Nae-Eung Lee, Sungkyunkwan University, Korea
Steve Muhl, Universidad Nacional Autonoma de Mexico
Pedro Nascente, Universidade Federal de São Carlos, Brazil, “Ti-Nb Based Alloy Coatings Produced by Magnetron Co-sputtering”
Ivan G. Petrov, University of Illinois, USA
Angus Rockett, Colorado School of Mines, USA, “Applying Thin Film Synthesis and Characterization Methods to Improving Photovoltaics”
Jan-Eric Sundgren, Swedish Association for Engineering Industries, Sweden

SPECIAL SESSIONS & EVENTS

Plenary Lecture (PL)

"The Fundamental Physics of Spray Coatings and Surface Impacts: Unit Process Studies of Hypersonic Particle Impacts"

Professor Christopher A. Schuh, MIT, USA

Monday, May 23, 2022, 8:00 a.m.

Many surface treatment processes involve impact events, including abrasive spray, peening methods, or spray coatings. The fundamental physics behind such processes, including deformation, bonding, and coating development, however, remain mysterious; the impacts are extremely fast and involve microscopic particles so that they are challenging to resolve. This talk will review a new line of research aimed at understanding the unit process of particle impacts at velocities into the supersonic range—we study individual $\sim 5\text{-}50\text{ }\mu\text{m}$ particles and record their approach and impact with a substrate using an all-optical single-particle test method with nanosecond time resolution. For hard particles, this method leads to quantitative measures of plasticity at extreme rates ($>10^7\text{ s}^{-1}$). For metallic particles, it quantitatively reveals the changes in plasticity that occur as particles approach the threshold velocity for bonding, as well as other deleterious transitions such as impact-induced melting and erosion. When combined with post-mortem characterization, details on microstructural evolution in extreme conditions can be discerned, including, e.g., dynamic recrystallization by a new mechanism that emerges at high rates, or the fracture and delamination of nanoscopic surface oxide layers.

Exhibitors Keynote Lecture (EX)

"Fabrication and Characterization of Industrially Important Films and Coatings"

Dr. Vincent Smentkowski, GE Research, USA

Tuesday, May 24, 2022, 11:00 a.m.

General Electric – Research (GE-R) has been the center of innovation for the GE businesses and strategic partners for more than a century. Our mission is to see, move, and create a brighter future through innovation. In 2018, GE-Research made a strategic decision to expand our collaboration with external partners to develop advanced and differentiating technologies in the areas of materials development, characterization, and analytics. The talk will highlight novel capabilities for film/coating deposition and how advanced characterization provided solutions and solved a problem that enabled important industrial-technological breakthroughs and ultimately the development of new/improved products. The presentation will focus on the characterization of both surface and sub-surface layers.

Special Interest Talks (SIT)

A new feature of highlighted presentations offers added value to the technical program. Lectures are dedicated to topics of fundamental interest for scientists and engineers in surface engineering. Presentations are individual and not "classic" day-to-day R&D business. Discussion of new developments and trends of relevance to ICMCTF, both in materials science and in methodology, in a pioneering state, with long-term impact. Selected critical reviews in a field of relevance to ICMCTF. Recognition of colleagues with pioneering and lasting impact on ICMCTF.

SIT1: Special Interest Session I

Christopher Muratore, University of Dayton, USA, "From High Temperature Tribology to Ultrasensitive Biomolecular Detection: The Versatility of Transition Metal Dichalcogenide Thin Films"

SIT2: Special Interest Session II

Megan Cordill, Austrian Academy of Sciences, Austria, "Evaluating Electro-Mechanical Reliability using In-Situ Methods"

SIT3: Special Interest Session III

Pantcho Stoyanov, Concordia University, Canada, "Tribological Coating Solutions and Lubrication Strategies for Gas Turbine Engines"

'FIRST TIMERS' SPECIAL

We want to welcome new participants in 2022 with a special 'First Timers' offer of **free student registration** for one student accompanying their adviser/supervisor registering for ICMCTF 2022 for the first time. Both the mentor and student are required to stay in the conference hotel to be eligible for the offer. Please contact the ICMCTF 2022 Program Chair, Samir Aouadi (Samir.Aouadi@unt.edu) if you have any questions regarding this opportunity.

ICMCTF VENDOR EXHIBIT

Visit the exhibit hall on Tuesday, May 24, from 12:00-7:00 p.m. and Wednesday, May 25, from 10:00 am – 2:00 p.m. to learn about new products, services and application techniques that will help improve all facets of R&D,

Engineering, Manufacturing, Quality Control and general laboratory operations. This is a great opportunity for attendees to interface with vendors who are eager to introduce their products that will satisfy your laboratory requirements and your specific research criteria. The exhibit hall is also a great place for networking. Join us each day for lunch and the exhibit hall reception on Tuesday at 5:30 pm. For questions regarding the exhibits, please contact Jeannette DeGennaro at jeannette@avs.org

Call for ICMCTF Awards

- **Graduate Student Awards:** The ICMCTF Graduate Student Awards are intended to honor and encourage outstanding graduate students in fields of interest to the Advanced Surface Engineering Division (ASED) of the AVS. ASED seeks to recognize students of exceptional ability who show promise for significant future achievement in ASED-related fields. The nominee must be a graduate student in science or engineering who is in good standing at a University with a recognized graduate degree program and the presenting author of an oral presentation at the annual ICMCTF conference. Nominees who receive their final research degree after the ICMCTF Abstract Submission deadline are still eligible for that year. However, previous Graduate Student Award winners are ineligible. Submission Deadline: November 1, 2021. Click here for [**Nomination Procedures.**](#)
- **Bunshah Award:** R.F. Bunshah Award and Honorary ICMCTF lectureship is intended to recognize outstanding research or technological innovation in the areas of interest to the Advanced Surface Engineering Division (ASED) of the AVS, with an emphasis in the fields of surface engineering, thin films, and related topics. The nominee shall have made pioneering contributions to the science or technology of surface engineering, thin films, or related fields of interest to ASED. Submission Deadline: November 1, 2021. Click here for [**Nomination Procedures.**](#)
- **Bill Sproul Award:** The Bill Sproul Award and Honorary ICMCTF lectureship is intended to recognize the achievements of a mid-career researcher who has made outstanding scientific and/or technological contributions in areas of interest to the Advanced Surface Engineering Division (ASED) of the AVS, with an emphasis in the fields of surface engineering, thin films, and related topics. Submission Deadline: November 1, 2021. Click here for [**Nomination Procedures.**](#)

ONLINE ABSTRACT SUBMISSION ONLY: <https://icmctf2022.avs.org/>

Deadline: 11:00 p.m. ET, MONDAY, November 1, 2021

Supplemental data (1-2 pages, 1MB) will also be accepted via the submission site.

Instructions may be found at the website above.

*****Please Note: A presenter may present one (1) ORAL AND one (1) POSTER presentation at ICMCTF*****

ORAL Sessions: Rooms will be set up with projectors, screens, microphones, and laptops (PCs).

POSTER Sessions: Each poster presenter will be allotted space that is 4 feet wide by 4 feet high. Please make your poster no larger than 46 inches wide by 46 inches high to ensure it fits nicely into the allotted space.

Any Questions? Please email [**icmctf@icmctf.org**](mailto:icmctf@icmctf.org)