High Temperature Materials Division

The High Temperature Materials Division

by Steven J. Visco

The High Temperature Materials (HTM) Division was established in 1921. It is one of the two oldest Divisions of The Electrochemical Society. Not surprisingly, the Division is in strong financial shape, allowing HTM to sponsor a number of outstanding symposia, as well as awards for scientific distinction. The focus of the Division has broadened significantly from its origins in high temperature materials chemistry and corrosion to encompass high temperature electrochemical systems such as solid oxide fuel cells, ionic membranes, sensors, and the science and technology of chemical vapor deposition and related processes. Notably, HTM is the lead sponsor for a number of well-attended symposia that have achieved international recognition as key events in their fields. These symposia include Solid Oxide Fuel Cells, Ionic and Mixed Conducting Ceramics, Solid State Ionic Devices, High Temperature Corrosion & Materials Chemistry, and Chemical Vapor Deposition.

A number of interests and symposia of the HTM Division reflect international concerns regarding the emission of greenhouse gases and the trend toward distributed power generation. In this sense, the Solid Oxide and Molten Carbonate Fuel Cells symposia sponsored by the HTM Division are very timely. In the U.S. alone, the national energy product exceeds $500 billion annually. The demand for energy in the United States is enormous and growing rapidly. According to a recent U.S. Department of Energy report,[1] demand will increase from a current capacity of 363 million kW to a projected capacity of 750 million kW in 2020. The global market is expected to reach 1275 gigawatts by 2015. Clearly, the utility market will respond to the increased demand. The important question is how this demand can be satisfied without simultaneously increasing greenhouse gases and other harmful emissions. To further complicate matters, the electric utility markets in the U.S. and overseas are undergoing deregulation leading to fierce competition, and shrinking R&D budgets for advanced power generation. Furthermore, in developing countries increased growth is often powered by

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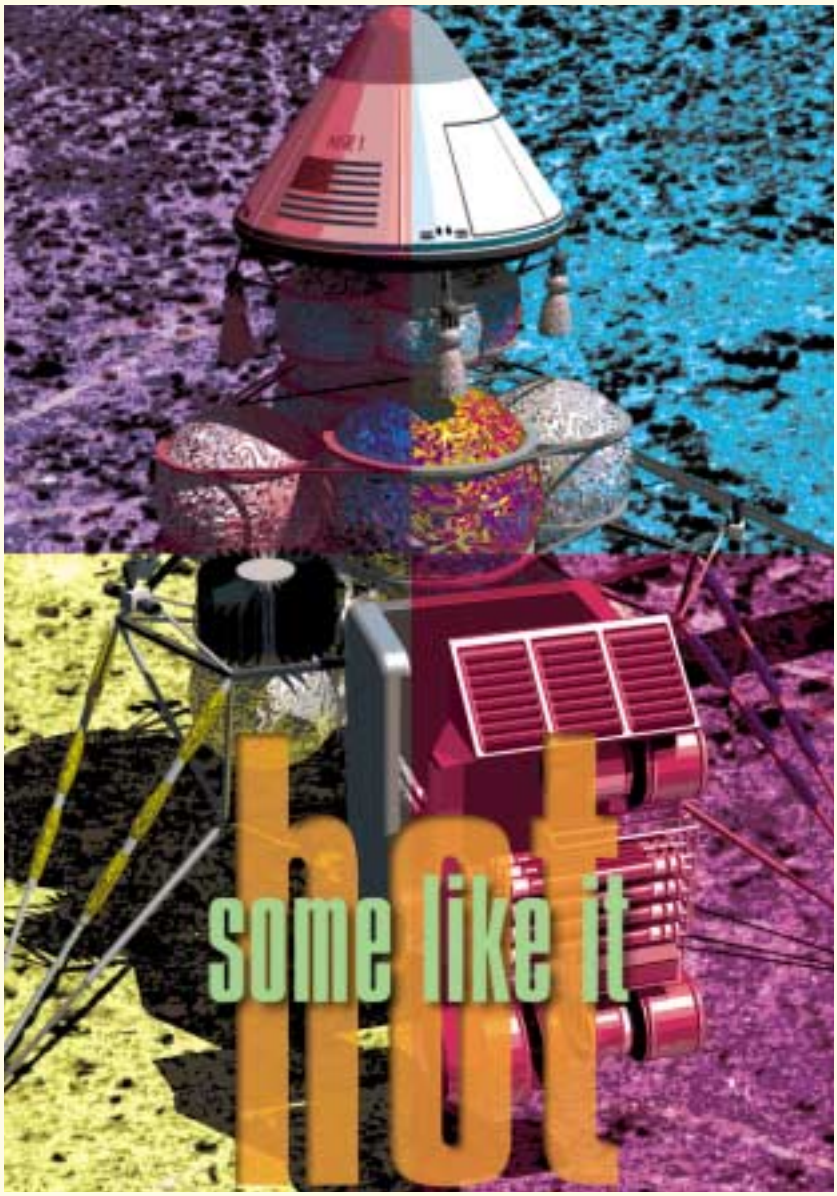

Our Featured Division

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polluting and energy inefficient technologies, such as high-sulfur coal burning plants, as the only affordable option. The market for new power generation has been projected to be worth $17 billion annually over the next 21 years. Fuel cells offer a reliable, non-polluting, energy efficient technology to meet increased demand. Among the various fuel cell technologies, solid oxide fuel cells (SOFCs) and molten carbonate fuel cells are among the best suited for distributed power generation due to their high system efficiency and ability to internally reform natural gas. The HTM symposia on these technologies as well as the symposia on Ionic and Mixed Conducting Membranes, Solid State Ionic Devices, and High Temperature Materials Corrosion and Chemistry present an ideal opportunity for fuel cell developers and researchers in the field to present and exchange ideas in order to accelerate the commercialization and fundamental understanding of these important technologies.

The HTM symposia on Ionic and Mixed Conducting Ceramics continues to attract a high caliber of both national and international speakers. This is due in part to the challenges involved in developing a theoretical framework to understand mixed conduction, and the commercial applications for these materials. The global markets addressed by ceramic membranes that enable syngas production and/or oxygen and hydrogen separation are very large. Accordingly, new developments in this field are watched closely, resulting in lively symposia. Topics covered in these symposia also include materials that also find application in solid oxide fuel cells and sensors.

A relatively new and related HTM symposium is Solid-State Ionic Devices, where papers are solicited in such topics as modeling and characterization of defect equilibria, theories for ionic and electronic transport, studies of interfacial and electrocatalytic properties of ion conducting ceramics, and novel synthesis and processing of thin films and membranes. The nature of the talks in these symposia cover applications in chemical sensors, fuel cells, gas separation membranes and reactors, and solid-state battery electrodes.

HTM also continues its historical interest in corrosion phenomena with its symposia on High Temperature Corrosion and Materials Chemistry. These symposia focus on the fundamental aspects of high temperature oxidation, high temperature corrosion, and other chemical reactions involving inorganic materials at high temperatures. One objective of these symposia is to encourage the development of theoretical models, based on experimental results, which allow the prediction of high temperature reactions and the rates at which they occur. A technique for measuring thermodynamic properties, Knudsen Cell Mass Spectrometry, is featured in this issue of *Interface*. Real-world problems such as alloy and ceramic oxidation, molten salt corrosion, volatilization reactions, and coating durability in complex environments are all addressed in these symposia. These issues are of interest for such diverse applications as power generation, aerospace propulsion, metal halide lamp design, and waste incineration.

Finally, the HTM Division has developed an excellent series of symposia covering phenomena related to chemical vapor deposition. These exceptionally well-attended symposia cover a diverse array of topics in CVD including gas-phase and surface chemistry, kinetics and mechanisms, thermochemistry, mass and energy transport fluid dynamics, and precursor design and synthesis, as well as topics in modeling and experimental verification of CVD processes. These symposia also cover applications in optical materials, semiconductors, superconductors, insulators, and metals. Further topics include dielectrics, ferroelectrics, magnetic materials, nuclear materials, hard coatings, refractories, organic materials, thermal and environmental barrier coatings, as well as multilayers, and solid lubricants.

The HTM Division also bestows two awards for scientists who have distinguished themselves in technical fields pertinent to the interests of the Division. The Outstanding Achievement Award was established in 1984 to recognize excellence in high temperature materials research and outstanding technical contributions to the field of high temperature materials science. The J. B. Wagner Award was established in 1998 to "recognize a young member of the Society who has demonstrated exceptional promise for a successful career in science and/or technology in the field of high temperature materials."

The call for nominations for the Outstanding Achievement Award occurs in August of odd years, and the nomination deadline is January 1 of even years. The award is presented at the fall ECS meeting of even numbered years. The most recent recipient of this award, Claude Bernard, is currently research director at the Centre National de la Recherche Scientific (CNRS) in Grenoble. Dr. Bernard's research is focussed on thermodynamics and CVD processes. Claude Bernard has authored or co-authored over 200 refereed technical papers and holds several patents on the elaboration of thin films for electronics or hard materials. Past recipients of the award were Costas Vayenas (1996), Subhash C. Singhal (1994), H. Schmalzried (1992), Robert A. Rapp (1990), Wayne L. Worrell (1988), and John B. Wagner, Jr. (1986).

The call for nominations for the J. B. Wagner Award is October of even years while the nomination deadline is January 1 of odd years. The J. B. Wagner Award is presented at the fall ECS meeting of odd numbered years. The first recipient of this relatively new award was Professor Suzanne S. Mohney in 1999. Dr. Mohney is an associate professor in the Materials Sciences and Engineering Department at Pennsylvania State University. Prof. Mohney received the award at the October 1999 ECS meeting in Honolulu, and gave an award address entitled, "Oxidation and Metallization of Group III Nitrides for High Temperature Devices." ■

References

1. Energy Information Administration Energy Outlook, The U.S. Department of Energy (1999).

FUTURE TECHNICAL MEETINGS

ECS & ISE Joint International Meeting
September 2-7, 2001
San Francisco, CA

ECS CENTENNIAL MEETING
May 12-17, 2002
Philadelphia, PA

October 20-25, 2002
Salt Lake City, UT

April 27-May 2, 2003
Paris, France

October 12-17, 2003
Orlando, FL

For information on these future meetings, contact the Society Headquarters office.
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