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EUROMAT 2015-Warsaw: A Bright Future for Materials Research in Europe

A TMS/FEMS International Scholar Program Report

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It was an honor and privilege to be selected as the 2015 TMS/Federation of European Materials Societies (FEMS) Young Leaders International Scholar. As a result of this award, made possible by the TMS Foundation, I was able to reconnect with existing colleagues in Europe, as well as establish important new collaborations in the field of ceramic composites for energy conversion and storage. My primary destination for this experience was Warsaw, Poland, which served as the center of materials research in Europe by hosting the European Congress and Exhibition on Advanced Materials and Processes (EUROMAT), September 20–24, 2015.

I am currently an associate professor in Materials Science and Engineering at Clemson University. My research group is focused on electronic ceramic materials for gas separation, structure/property relations in solid oxide fuel cell systems, and radiation-tolerant crystalline ceramics for applications in nuclear energy. Materials typically used in these applications are ceramic/ceramic or ceramic/metal composites. We are particularly interested in the role that the interface plays in determining properties and how the structure of the interface is determined by processing. This work is funded by a recently completed U.S. Department of Energy (DOE)-Basic Energy Sciences Heterogeneous Functional Materials Center (HeteroFoaM) project; a currently active DOE-Nuclear Energy University Programs project, A New Paradigm for Understanding Multiphase Ceramic

Pawel Zieba, head, Institute of Metallurgy and Materials Science, Polish Academy of Sciences (left) presented Brinkman with recognition of his TMS/FEMS Young Leaders International Scholar Award as part of the keynote talk that Brinkman gave at Euromat 2015.

Waste Form Performance; and a DOE-Experimental Program to Stimulate Competitive Research (EPSCoR) project, Radionuclide Waste Disposal: Development of Multi-scale Experimental and Modeling Capabilities.

I made a brief stop in Switzerland on my way to Warsaw and paid a visit to my graduate school alma mater, the Swiss Federal Institute of Technology (EPFL) in Lausanne, Switzerland. Lausanne also happens to be the hometown of the current FEMS president, Margarethe Hofmann, who hosted me for a welcome dinner on the day of my arrival. The following morning, I delivered a lecture, "Crystalline Ceramics for Nuclear Waste Immobilization and Membrane Separations" at the EPFL Institute of Materials Ceramics Laboratory, hosted by Nava Setter. This was followed by a discussion with EPFL faculty on their recent work on controlling ferroelectric properties with charged interfaces or domain walls.

I then traveled on to Warsaw, where I met the TMS delegation en route to the conference site. The well-received opening plenary talk was presented by 2015 TMS President Patrice Turchi and set the stage for an excellent technical meeting.

EUROMAT is similar in format to the TMS annual meeting with opening plenary sessions, followed by parallel symposia focused on fundamentals of structure and processing. The meeting also covers application areas such as energy and biomaterials, along with sessions focused on education and technology transfer. I gave a keynote lecture, "Multiphase Ceramic Composites for Membrane Separations and Nuclear Waste Immobilization: The Role of the Interface," at the Materials for Energy Symposium.

A highlight of the meeting was the conference gala dinner held at the Palace of Culture and Science in downtown Warsaw. The palace is an impressive building that dominates the central skyline. At night, it is lighted to emit a bright purple glow. Despite the bright exterior, the building has a dark history. It was gifted to the Polish people by Joseph Stalin at the end of the World War II, and as one colleague at the dinner succinctly stated, "no one refused a gift from Stalin." The weight of history melted away in the warm and cheery interior of the building, thanks to the kindness of our Polish conference organizers, as well as the traditional Polish welcome drink served upon entry.

While in Warsaw, I also had the opportunity to visit Michal Basista, the head of the Advanced Composite Materials Division Institute of Fundamental Technological Research, Polish Academy of Sciences. While there, I presented a lecture, "Multiphase Ceramic Composites: The Role of the Interface." Basista is also one of the founding members of a European Research Network called the European Virtual Institute on Knowledge-based Multifunctional Materials (KMM-VIN). This network coordinates academic and industrial research on the topics of transportation, energy, and health to establish effective cooperation on advanced materials and technologies. In addition to the discussion

Brinkman attended the Euromat 2015 gala dinner with the rest of the leadership delegation from TMS. Pictured from left: James J. Robinson, TMS Executive Director; Lynne Robinson, *JOM* Contributing Editor; Michèle Turchi; Patrice Turchi, 2015 TMS President; Brinkman.

of potential individual collaborations regarding processing of metal ceramic composites, I learned a great deal about how materials research funding is being handled in Europe and the important role that multi-national organizations such as KMM-VIN can play to put academics and industrial researchers on the same page in tackling common problems.

In addition to presenting at and attending Euromat 2015, Brinkman was able to tour and share ideas with colleagues at several European laboratories. Brinkman (center front) pauses during one of these experiences for a photo with the team at the University of Silesia, Institute of Physics, Katowice, Poland.

My last stop in Poland was Katowice in the southwest region of the country to visit the University of Silesia. My host was Krystian Roleder at the Institute of Physics. After meeting with the institute director and touring the laboratories, I gave a presentation, "Enhanced Grain Boundary Ionic Conductivity in Mixed Ionic and Electronic Conductors." The discussions that followed were focused on crystal growth of select compounds of mixed ionic and electronic conductors for separation membranes and nuclear waste immobilization that would enable the characterization of true bulk properties without the influence of grain boundaries.

I wrapped up my trip with a brief industrial site visit to Zagreb, Croatia, hosted by Marko Budimir of the Institute of Nuclear Technology (INETEC). This institute provides inspections of structural integrity of nuclear reactors by non-destructive testing with high fidelity piezoelectric materials. I was most interested in learning about the potential application of the institute's technology to the testing of cement and ceramic-based waste forms to quantify crack formation and propagation in my present work.

I was left with two lasting impressions from my European visit. The first was recognition of the inherent diversity of European technical meetings. In my current town of Clemson, traveling 100 miles takes me from South Carolina to North Carolina. Granted, we have better barbecue in South Carolina. However, one hardly experiences the wholesale change in culture, language, and tradition that occurs over relatively short distances on the European continent.

Marek Darecki, a plenary speaker from WSK, a Polish aerospace company in Rzeszów that is now part of Pratt and Whitney, made my second lasting impression. Slowik recounted his company's history and struggles since its founding in 1937, through the turmoil of World War II, the Cold War that followed, and on to its present success. It was a remarkable and inspiring story of overcoming adversity.

I would like to sincerely thank the TMS Foundation and FEMS for making these experiences possible for me. I would also strongly encourage early career TMS members to explore the Young Leaders International Scholar opportunity for their own professional and personal development.

Kyle Brinkman is an associate professor at Clemson University, South Carolina, the 2015 TMS/FEMS Young Leaders International Scholar, and a 2011 TMS Young Leaders Professional Development Awardee. For additional information on these and other TMS young professional programs, visit the TMS Professional Honors and Awards Recognition Program website at awards.tms.org or contact Deborah Hixon, TMS Awards and Recognition Specialist, at hixon@tms.org.