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Name of recipient: The Minerals, Metals & Materials Society (TMS)

Project title: Neutron and X-ray Studies of Advanced Materials VII Symposium at the 143rd TMS Annual Meeting & Exhibition

Name of project director/principal investigator: Dr. George Spanos, PhD, TMS Technical Director

Consortium/teaming members:

- Rozaliya Barabash, Oak Ridge National Laboratory
- Gernot Kostorz, ETH
- Brent Fultz, California Institute of Technology
- Peter Liaw, The University of Tennessee

Executive Summary

Discussion of 1) how the research adds to the understanding of the area investigated; 2) the technical effectiveness and economic feasibility of the methods or techniques investigated or demonstrated; or 3) how the project is otherwise of benefit to the public.

The Neutron and X-Ray Studies of Advanced Materials VII Symposium, held at the 2014, 143rd Annual Meeting of The Minerals, Metals, and Materials Society (TMS), brought together experts, young investigators, and students from this sub-discipline of materials science in order for them to share their latest discoveries and develop collaborations. This annual symposium, which is organized by The Minerals, Metals, and Materials Society, is an important event for this community of scientists. This year, over 100 high-level technical talks were delivered over the course of the four day event. In addition, the large number of students and young investigators in attendance ensured the maximum benefit to the next generation's work force in this area of study.

The science surrounding the utilization of neutrons and x-rays to study advanced materials is becoming increasingly important in increasing the understanding of how the exceptional materials properties of such materials arise. In particular, x-rays and neutrons can be used to visualize material structures at an extremely high resolution and in some cases, three dimensions—allowing unprecedented insights into the mechanisms governing certain materials properties such as strength and toughness. Moreover, some of these techniques allow materials to be visualized without damaging the material, approaches known as non-destructive evaluation or “NDE”. This allows materials to be studied in 3 dimensions while undergoing change in real time which represents an important (and long sought-after) advancement in materials science.

The types of interactions afforded by this event are beneficial to society at large primarily because they provide opportunities for the leaders within this field to learn from one another and thus improve the quality and productivity of their investigations. Additionally, the presence of young investigators and students with technical interests in this field provides promise that the United States will continue to be a leader in this area. The support provided by the Department of Energy for this event directly enhanced its impact on the field by helping a number of students, young investigators, and technical experts attend and participate in this event.

Goals & Accomplishments

Comparison of the actual accomplishments with the goals and objectives of the project.

The Neutron and X-ray Studies of Advanced Materials VII symposium, held at the TMS 2014 Annual Meeting & Exhibition in San Diego, California (February 16-20, 2014) was a great success. At this

symposium, almost 70 talks were delivered over the course of the symposium. Many of these talks were delivered by invited experts or students.

The intent of this specific symposium was to bring together experts in the field to present the latest developments on the science surrounding neutron and x-ray scattering techniques for advanced characterization and investigation. Thanks to support provided by the Department of Energy, Office of Basic Energy Sciences, the symposium also hosted a number of students and young investigators that otherwise may have had financial hardship in attending the meeting.

The budget request for this symposium support was \$7,000 to be provided as support to a total of 6 students, 2 post-docs, 2 young investigators, and 2-4 select authors. Ultimately, the \$7,000 Conference registration and/or travel support was provided to seven students, three post-doctoral researchers or young investigators, and three select authors, so project performance matched very closely with the stated objectives. This symposium proved to be a valuable experience for students, junior investigators, and seasoned researchers alike. Due in part to support from the Department of Energy many young scientists, students and post-docs attended the symposium.

Project Activities

Summary of project activities for the entire period of funding, including original hypotheses, approaches used, problems encountered and departure from planned methodology, and an assessment of their impact on the project results. Include, if applicable, facts, figures, analyses, and assumptions used during the life of the project to support the conclusions.

This symposium was partially supported by DOE funding which was provided to offset the conference attendance expenses of students and young investigators in order to maximize the symposium's impact on the next generation's workforce as well as some select, note-worthy authors and attendees in order to maximize the advanced technical quality of the symposium.

This symposium brought together research experts and students with interests in the characterization techniques and applications of neutrons and x-rays, particularly as they pertain to understanding the properties and mechanisms of advanced materials. A strong technical program, containing almost 70 presentations was developed and organized around the following technical sessions. The titles and authors of keynote talks within the symposium sessions are listed as well to provide a sample of the technical topics covered. The strong list of keynote and invited speakers contributed to the high quality of technical content.

Diffraction Centennial - Historic Perspective and Future Challenges

- Local Structure in Wüstite, Fe_{1-x}O , by Single Crystal Diffuse Scattering and PDF Analysis: Richard Welberry¹; Darren Goossens¹; ¹Australian National University

Complex Materials

- Atomic Dynamics and Viscosity in the Liquid: Takeshi Egami¹; ¹University of Tennessee

Advanced Structural Mapping

- Advanced Synchrotron X-ray Studies of Recrystallization: Dorte Jensen¹; Yubin Zhang¹; ¹DTU

Stressed Materials

- Slip Systems and Dislocation Densities from X-ray or Neutron Diffraction: Tamás Ungár¹; ¹Eötvös University Budapest

Multi-Modal Monitoring of Structure Evolution

- Metals under Complex Conditions: In-situ and real-time Information Revealed by Neutron and Synchrotron X-Ray Diffraction: Klaus-Dieter Liss¹; ¹Japan Atomic Energy Agency; Australian

<p>Nuclear Science and Technology Organisation</p> <p>Static and Dynamic Displacements</p> <ul style="list-style-type: none"> • Powder Diffraction and Lattice Dynamics of Nanocrystals: Paolo Scardi¹; ¹University of Trento <p>Plasticity and Deformation</p> <p>The support provided by the Department of Energy for this event proved to be highly valuable to the success of the symposium in that it contributed to a strong attendance of students, young investigators, and special attendees.</p>
<p>Products Developed</p> <p>Products developed under the award and technology transfer activities, such as publications, websites or other internet sites, networks or collaborations fostered, technologies/techniques, inventions, or other products.</p> <p>A number of papers from this symposium were submitted to the journal, Metallurgical and Materials Transactions A. The symposium papers that are accepted by the journal review board will be grouped and published together. These papers will then be available in print and digitally within the Metallurgical and Materials Transactions A journal via the publisher, Springer at www.springerlink.com.</p>
<p>Computer Modeling</p> <p>N/A.</p>