Ellen Cerreta
Trustee-Elect (2015-2018)

Dr. Ellen Cerreta
Group Leader, MST-8
Materials in Radiation and Dynamic Extremes Group
Los Alamos National Laboratory
Los Alamos, NM

Ellen Cerreta is the Group Leader for MST-8, the Materials in Radiation and Dynamic Extremes Group, at Los Alamos National Laboratory. She joined Los Alamos as a Post-Doctoral Associate in 2001. Ellen received her BS in Aerospace Engineering from The University of Virginia and her Ph.D. in Materials Science and Engineering from Carnegie Mellon University. Since coming to Los Alamos, she has focused on the correlation of microstructure to mechanical response of metals and alloys, with the support of the Office of Basic Energy Sciences, the national defense, global security, and energy programs, and Laboratory Directed Research and Development (LDRD). Her research has had a focus on material behavior in dynamic loading environments. Ellen is an adjunct faculty member in The Institute of Shock Physics at Washington State University and she joins the ASM Board of Trustees in October of 2015.

Abstract – Damage Tolerant Metals for Extreme Environments

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Dr. Ellen K. Cerreta
Group Leader, MST-8
Materials in Radiation and Dynamic Extremes Group
Los Alamos National Laboratory
Los Alamos, NM

Abstract: While material failure has been studied for many years, our current ability to predict and simulate evolving damage in the extreme environments of high stress and high strain rate loading remains limited. This is particularly problematic because material and component failure under these types of dynamic loading conditions can often lead to catastrophic consequences. One reason for this limited predictive capability is the lack of understanding of the linkages between the process-induced as well as the evolved microstructure and damage. To this end, within the Materials Science in Radiation and Dynamic Extremes Group (MST-8) at Los Alamos National Laboratory, the role of microstructure on the early stages of damage has been studied in a number of metals and alloys using a combination of small scale experiments and simulations. These multi-length scale studies have identified a number of deterministic linkages between damage nucleation, damage growth and microstructural features such as: inclusion/metal interface characteristics, bi-metal interfaces, grain boundary types, grain boundary orientation, and grain orientation. Here, the tools utilized to advance predictive models for damage and failure in extreme environments as well as the work to design next generation materials for enhanced properties, particularly damage tolerance, will be discussed.

Abstract – Strength at Pressure

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Dr. Ellen K. Cerreta
Group Leader, MST-8
Materials in Radiation and Dynamic Extremes Group
Los Alamos National Laboratory
Los Alamos, NM

Abstract**:** Under conditions of static and dynamic loading to high pressures or stresses, it can be critical to quantify the strength of a material and it is well understood that material microstructure controls properties like strength. It is also expected that microstructures, particularly for many important structural metals like iron and titanium, are evolved or modified in significant ways when subjected to high stresses. These modifications include microstructural refinement due to twinning, significant storage of plastic work within grains, and even phase change. Therefore, it follows that the strength of the material under stress is dependent on the microstructure evolved under stress. This is problematic, as until recently the materials science and physics communities have been limited to post mortem interrogation of materials exposed to high stresses and little is quantified about the actual microstructures under load. Current predictive capabilities for strength under high stress utilize the known microstructures prior to loading and under moderate stress conditions. Post mortem investigations of material subjected to extremes of stress indicate that this may be problematic.

Here, recent work on titanium and zirconium metals that includes the use of current light sources, such as the Advanced Photon Source at Argonne National Laboratory, will be presented to discuss quantification of structure at high stresses. This will be related to on-going efforts at Los Alamos National laboratory to develop phase-aware, predictive modeling capabilities for material strength at pressure.