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Investigating the Influence of Alloying and Grain Size on Low-Cycle Fatigue Behavior in Magnesium

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ABSTRACT:

The influence of grain size and alloying on the mechanical behavior during fatigue is being investigated. It is widely understood that grain characteristics (e.g. size and crystallographic orientation) can have a significant effect on the mechanical behavior of metallic materials. To understand the influence of grain size and alloying on mechanical behavior, low cycle fatigue experiments using in-situ and ex-situ techniques were performed. The twinning and detwinning behavior of extruded fine-grained pure Mg and Mg-4Al was investigated using in-situ high energy x-ray diffraction (HEXD) under displacement controlled, fully-reversed low cycle fatigue conditions. Measurements were conducted at three levels of applied strain. At cycle strains greater than 0.5%, tension-compression loop asymmetry was observed during cyclic loading which can be related to twinning during the compressive portion of the cycles followed by detwinning during the unloading (from peak compression) and tensile loading portions of the cycles. The twinning and detwinning were characterized by monitoring the evolution of x-ray diffractions peaks associated with the basal {0002} planes throughout a cycle. It was determined that the stress needed to initiate twinning during compression was independent of grain size and Al addition and that the stress needed for complete detwinning was closely related to the twin volume fraction. Ex-situ, strain-controlled LCF experiments were performed on both fine and coarse-grained pure Mg alloys as well as Mg-4Al. It was also found that for a given total strain amplitude the fatigue life was slightly increased in the fine-grained pure Mg condition.

BIOGRAPHY:

Ariel Murphy-Leonard is originally from Alabama. She completed her undergraduate education at the University of Alabama where she earned a degree in Metallurgical and Materials Engineering. After undergrad, Ariel worked in Research and Design at Alstom Inc in the corrosion research labs for a year. In 2013, she began her PhD journey at the University of Michigan in Materials Science and Engineering. During her time at Michigan she led and worked on many teams aimed at increasing the number of underrepresented minorities in engineering including developing and implementing a leadership camp for female engineering students in Monrovia, Liberia. Ariel earned her PhD in November 2018 and is currently a NRC Research Associate at the Naval Research Laboratory in Washington, DC. Ariel enjoys baking, traveling, and reading.

**Doherty Hall 2210, 11:30AM
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