The Summer Undergraduate Research Fellowship (SURF) Symposium
4 August 2016
Purdue University, West Lafayette, Indiana, USA

Rapid Grain Boundary Mobility at Ambient Temperatures

Jarrod M Lund
Department of Mechanical Engineering, Brigham Young University
R. Adam Bilodeau and Rebecca Kramer
Department of Mechanical Engineering, Purdue University

ABSTRACT

Understanding and measuring the influence of grain boundaries (planar defects in the crystalline structure of materials) and their motion has become a dominant aspect in materials research, with applications in additive manufacturing, fatigue prevention, and material modeling. However, modeling grain boundaries and grain boundary mobility (GBM) is difficult due to the high temperatures or external stresses, imaging solutions compatible with the material system, and long time-scales required to create measurable experimental results. In this paper, we introduce a novel material system that allows for easy and fast visualization of GBM. A drop of liquid metal eutectic gallium indium (eGaIn) placed on indium foil will penetrate along grain boundaries, decreasing the internal stresses at grain boundary interfaces and enabling rapid GBM on the order of minutes. Due to the low melting temperature of indium, the entire process is observable without requiring special temperature-control equipment. Using a scanning electron microscope, the GBM of several grains of indium can be observed at a high resolution simultaneously. The value of the material choice and visualization process is shown by measuring the motion as a function of curvature for several grain boundaries.

KEYWORDS

grain boundary, grain boundary mobility, grain boundary curvature