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Energy of slip nucleation and transmission at grain boundaries

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Grain boundaries (GBs) provide a strengthening mechanism in engineering materials by impeding dislocation motion. In a polycrystalline material, there is a wide distribution of GB types with characteristic slip transmission and dislocation nucleation behaviors. There is a strong need to quantify the energy barriers of the individual GBs. We introduce a methodology to calculate the energy barriers during slip-GB interaction, in concurrence with the general stacking fault energy curve for slip in a perfect FCC material. By doing so, we calculate the energy barriers for slip transmission and nucleation from various classifications of GBs. The character and structure of the GB plays an important role in impeding slip within the material. From this analysis, we show that there is a strong correlation between the energy barrier and static interfacial boundary energy. The results have profound implications in understanding mechanical response influenced by the underlying grain boundary characters.

Biography

Michael D. Sangid received his PhD in Mechanical Engineering from the University of Illinois at Urbana-Champaign (UIUC) in 2010. After his Master's degree, Dr. Sangid spent two years working in Indianapolis, IN for Rolls-Royce Corporation, specializing in material characterization, fatigue, fracture, and creep of high temperature aerospace materials before resuming his education in 2007. In the fall of 2011, Dr. Sangid started as an assistant professor at Purdue University in the School of Aeronautics and Astronautics, where he continues his work on building computational materials models with experimental verification and validation efforts.

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