15th International Conference on Fracture (ICF15)
June 11-16, 2023 Atlanta, GA USA

INTERFACE NANOSTRUCTURES AND MECHANISMS CRITICAL FOR FATIGUE

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Abstract

Interfaces are the most inconspicuous and yet the most profound influencers of material behavior by far. They are capable of imparting large enhancements in fatigue-resistance and increase in failure strength, authoritatively dictating performance in several domains spanning biomedical devices, energy-harvesting, aeronautics, and space exploration. The enhancements in safety and performance fundamentally rests on a foundation of materials where metal fatigue is alleviated by materials design. A gaping scientific void debarring such a development is the lack of understanding of the two most fundamental interfaces in functional materials: Twin Boundaries (TBs) and Habit Planes (HPs). The current talk will address this void, explaining nanostructures and evolutionary mechanisms of these interfaces under external stimuli at multiple scales. This understanding will further be catapulted by the development of a suite of novel, ab-initio, fully-predictive microstructural models from the nano- to the meso-scale, explaining the key interface characteristics responsible for fatigue. Such an approach will advance knowledge on TBs, topological nanostructure of the HP, reveal their interplay in fatigue-damage mechanisms and establish tailorable design targets to alleviate fatigue. Such an approach dealing with large number of TBs and materials with varying compositions in the thousands require research that is devoid of empiricism and transcend current methodologies. Consideration of twin-slip interactions further increase the number of possible cases to consider in establishing the strength and fatigue resistance of structural materials.