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Connecting grain boundary properties to microstructural evolution in polycrystalline metals[1]

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Within the last decade, both computational and experimental methods have evolved to the point that large-scale surveys of grain boundary properties have become tractable. Such studies have provided new information and insight about boundary structure, energetics, motion mechanisms, and mobility on a scale that invites application to polycrystalline systems. However, the complex behavior revealed in these studies often generates as many questions as it answers. This presentation will review pertinent computational and experimental studies of grain boundary properties in FCC metals, concentrating on boundary energy and mobility. The goal will be to identify the microstructural signatures of boundary properties in polycrystalline grain boundary networks. Topics will include how boundary energy and mobility trends manifest in real microstructures; the effects of shear coupling on boundary motion in bicrystals and polycrystals; the significance of boundaries that move in a non-thermally-activated manner to low temperature grain growth; and the consequences of the thermal roughening transition on grain stagnation. In each case, individual grain boundary properties couple with the characteristics of the grain boundary network to generate diverse microstructural outcomes.

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