Graduate Student Research Seminar

Spring 2023

On grain boundary segregation and solute drag in multicomponent alloys

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Advisor: Dr. Fadi Abdeljawad

Monday, March 13th

3:00 pm (EST) – 132 Fluor Daniel Building

Abstract

Most material systems are polycrystalline aggregates; each two differently oriented grains meet at an internal interface, termed a grain boundary (GB). GBs play a critical role in many phenomena during materials processing or under service conditions. Of particular interest is GB migration and the resultant grain growth, as these processes control many crystal-size dependent properties in metallic systems. In multicomponent systems, the interaction of migrating GBs with elemental species influences GB dynamics, where the GB solute atmosphere exerts a drag, resisting GB migration. Here, we present a solute drag model in regular solution multicomponent alloys that accounts for solute-solute and solute-parent interactions considering different segregation-desegregation regimes. A universal drag-velocity relation is proposed and used to investigate how various materials parameters affect the stabilization of the nanocrystalline structures in a wide range of engineering alloys. In broad terms, our model provides avenues to design more stable multicomponent alloys using GB segregation.

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