MATERIALS ENGINEERING

SEMINAR

"INFLUENCE OF ZR SOLUTE ON THE STRUCTURAL, MECHANICAL, AND THERMAL PROPERTIES OF NANOTWINNED AL ALLOYS"

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ABSTRACT

Aluminum (Al) possesses a plenitude of remarkable properties, such as strong corrosion resistance, high thermal and electrical conductivity, and high specific strength. However, Al and its alloys are still remarkably weaker than most high strength steels and susceptible to drastic softening at high temperatures, preventing many applications where its low density would be beneficial. Severe plastic deformation can yield ultra-fine grained Al alloys with similar strengths as steels, although they are highly unstable even at room temperature. Nanotwinned metals have demonstrated concomitant strength and ductility, enabled by twin boundaries which simultaneously act to inhibit dislocation motion and generate partial dislocations that aid in plasticity. In spite of having a high stacking fault energy, nanotwins have been introduced into Al alloys using transition metal solutes during magnetron sputtering. This thesis aims to explore the impact Zr has on the microstructure, deformation, and thermal stability of nanotwins in NT Al.

Our studies identify how Zr aids in the formation of a significant volume fraction of 9R phase and an abundance of finely spaced incoherent twin boundaries, leading to a maximum hardness of 4.2GPa. They further uncover through *in-situ* micropillar compression that NT Al-Zr alloys are highly deformable and reach a flow stress of ~1.1GPa. Constant strain rate nanoindentation tests demonstrate the enhanced strain rate sensitivity in NT Al-Zr alloys. Zr is also identified to be a remarkable thermal stabilizer when incorporated into NT Al-Co alloys, with no apparent softening up to 450 °C (0.78 T_m). The influence of substrate texture on nanotwinned Al-Zr alloys microstructure was also thoroughly explored.

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Place: HAMP 1266 or via Webex: https://purdue.webex.com/meet/xzhang98

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