Department of Materials Science and Engineering

Ph.D. Proposal

11:00 AM
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Hill Conference Room

Effect of Processing Variables on Mechanical Properties of Mg Composites Reinforced with MAX Phases

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Abstract:
The MAX phases and hexagonal metals, among many other plastically anisotropic solids, have been classified as kinking nonlinear elastic, KNE, solids. A sufficient condition for a solid to be KNE solid is plastic anisotropy, which for hexagonal solids implies a c/a ratio > 1.4. The signature of these solids is formation of fully reversible, reproducible stress-strain loops during cyclic loading. The full reversibility of theses loops is believed to be caused by incipient kink bands, IKBs, which are comprised of multiple, parallel dislocation loops, which remain extended only if the load is applied; when the load is removed, they shrink, or are annihilated altogether.

Recently, it has been reported that a simple method of pressureless spontaneous melt infiltration of Mg into a porous perform of Ti_2AlC resulted in solids which exhibit ultrahigh damping in addition to other important properties such as machinability, stiffness and light weight. Moreover, it was shown that the Mg grains are at nano scale and are extraordinary thermally stable, wherein heating the composite to 50 °C over the melting temperature of Mg did not lead to grain growth of nanocrystalline, nc, Mg. The reasons for the formation of the nc-Mg grains and their exceptional thermal stability are currently not understood.

The goals of this research are three-fold. The first is to understand why the Mg nano-grains form. The second is to understand the reasons that make the nc-Mg thermally stable. The third goal is to optimize the fabrication process of these composites in order to obtain exceptional properties and/or combinations of properties that hitherto have not been possible. Thus, in parallel to enhancing our understanding of the phenomena that keep the Mg grains at the nano scale, the mechanical properties of these nc-Mg composites will be studied as a function of matrix and MAX-phase chemistries, as well as the grain size and loading of the latter.