MONASH University

Monash Centre for Electron Microscopy & Department of Materials Engineering

SEMINAR

Structure-Derived Properties in Non-Equilibrium Alloys

Ryan T. Ott

Division of Materials Sciences and Engineering, Ames Laboratory, US

Thursday 2 October 2014
11 – 12 pm
Science Lecture Theatre S9, Building 25

Abstract

A large part of our group's work at Ames Laboratory focuses on understanding how structure-derived properties (e.g, mechanical, magnetic, etc.) can be controlled and tailored through processing. This talk will cover two areas of our current research. The first part will focus on our research into understanding the structures and dynamics in condensed systems. This is important since numerous materials used in energy technologies rely on far-from-equilibrium structures. A common method for designing these structures is to synthesize amorphous materials via non-equilibrium processing (e.g., melt spinning or magnetron sputtering) followed by controlled devitrification. Understanding the devitrification pathways of amorphous materials can be quite complicated, however, due to the numerous processes that affect the phase selection. We have examined the devitrification behavior of Al-RE (RE = Sm and Tb) metallic glasses that are prepared by melt spinning and magnetron sputtering. This combined experimental and computational approach shows that the phase selection is strongly dependent on the synthesis technique, with the amorphous alloys prepared by magnetron sputtering exhibiting vastly different devitrification pathways than the melt spun alloys. Specifically, alloys prepared by magnetron sputtering undergo low temperature phase separation prior to the formation of fcc-Al, while the melt spun alloys show the direct formation of crystalline phases. The dependence of the crystallization pathways on the starting amorphous structure is discussed.

The second topic I will discuss is part of our work through the Critical Materials Institute (CMI) led by Ames Laboratory. The CMI is an Energy Innovation Hub created by the U.S. Department of Energy to addresses critical materials. The supply and demand imbalance often associated with these critical materials such as rare earth (RE) metals makes finding suitable alternatives increasingly necessary. RE metals are especially important for permanent magnet alloy where their exceptional properties are necessary for numerous energy technologies. Identifying appropriate substitutes that do not rely on critical materials is a difficult undertaking that is further complicated by the fact that more established combinatorial techniques such as thin film deposition are not always appropriate for studying magnetic properties due to their strong dependence on sample geometry. Here were present a bulk combinatorial approach for synthesizing alloy libraries using laser engineered net-shaping (i.e., 3D printing). This technique feeds powders in different ratios into a melt-pool created by a laser to create samples with bulk (millimeters) dimensions. By analyzing these libraries with autosampler DSC/TGA and VSM machines, we are able to rapidly characterize the thermodynamic and magnetic properties of the libraries. Results from various model systems are presented and the implications for designing permanent magnets with reduced RE metals are discussed.

Convenor: Associate Professor Laure Bourgeois
Email: laure.bourgeois@monash.edu

Visitors are most welcome: Please note that there is a designated Visitors Car Park (N1) clearly ground-marked by white paint and tickets, at a cost of $1.4/hour for up to 3 hours, available from a dispensing machine. This high-rise carpark is located on the following Clayton Campus Map, Ref. B2.

Printable version of the Clayton campus map (pdf 833 kb) (Please right click to open link)