KOÇ UNIVERSITY

Math-Science Seminar

Speaker: Ersan Üstündag (Department of Materials Science, California Institute of Technology)

Title: Internal Stresses in Bulk Metallic Glasses

Date and Time: Monday, June 11, 3:15 pm.*

Place: Room Z42, Science Building, Koç University, Rumelifeneri Yolu, Sariyer 80910 Istanbul.

Abstract: Bulk metallic glasses (BMG's) have recently become popular due to the development of new alloys that yield a glassy structure even with "conventional" metal processing such as casting. The unique properties of BMG's potentially place them among significant engineering materials: very high strength (1.9 GPa) and fracture toughness (20-55 MPa.$m^{1/2}$), a near theoretical specific strength, excellent wear and corrosion resistance, and a high elastic strain limit (up to 2%). This presentation will discuss internal stress generation in BMG's via two major mechanisms:

Thermal Tempering of BMG's: Due to their very low thermal conductivities and the relatively fast cooling rates used, BMG's experience large thermal gradients during processing. These gradients lead to residual stress buildup due to the viscoelastic nature of BMG's. As a result, a thin surface layer contains compressive stresses balanced by a tensile stress in the interior. Analytical and finite element modeling was performed to predict the values and distribution of such stresses as a function of processing conditions. Stress measurements were then conducted using mechanical relaxation methods and neutron diffraction. It was shown that significant stresses, on the order of several hundred MPa, can be generated in BMG's.

Internal Stresses in BMG Composites: Composites made of BMG matrices reinforced with metallic fibers or inclusions have been shown to possess superior mechanical properties compared to monolithic BMG's. However, the thermal expansion mismatch between the reinforcements and the matrix as well as the elastic and plastic incompatibilities between the two phases generate internal stresses. Neutron and high-energy X-ray diffraction techniques were employed to characterize these stresses. The results will be presented along with their implications for the mechanical behavior of the composites.

*Refreshments to be served in Science Building, Room Z40 at 3:00 pm.