UNH Materials Science Seminar

13:10-14:00, Wednesday, Feb. 3, 2010
DeMeritt Hall 240
University of New Hampshire

Investigation of Magnetic Pulse Welding on Similar and Dissimilar Materials

Yuan Zhang

Department of Materials Science and Engineering, The Ohio State University

Magnetic Pulse Welding (MPW) utilizes electromagnetic force as the acceleration to make impact welding within microsecond duration. It is a solid state welding and there is no significant heat affect zone (HAZ) in the welded region. It can be applied onto both similar and dissimilar materials welding. Additionally, the welding design for MPW process is quite flexible with high reproducibility. In this presentation, MPW has been applied onto Al-Al, Cu-Cu pairs for similar welding, and Al-Cu, Al-Fe, and Cu-BMG pairs for dissimilar welding. The impact velocity and impact angle were investigated. Tensile test, peeling test and microhardness test indicated that the impact welded interface has higher strength than the base metals due to shock hardening effect by high strain rate deformation. In order to understand the mechanical property changes and the joining mechanism for MPW, the welded interfacial microstructure was characterized by OM, SEM, TEM and 3DAP. The interfacial microstructure characterization shows along the welded interface, the metallic bound formed in a wavy fashion. It is also found that small amount of intermetallic phases discontinuously distributed in the hump of certain waviness. With adiabatic heating and high strain rate deformation, the microstructure of the welded region undergoes heavy evolution. TEM studies revealed elongated subgrains, columnar-like grains, submicron and nano-crystal grains, lamellar microbands, and microtwining. The high dislocation density and large misorientation of grain boundaries accommodated the adiabatic heating and deformation. Atom probe tomography suggested that short range (~10nm) diffusion occurred in the bonded interface. The heavily refined microstructure and short range diffusion along the welded interface make the MPW joint stronger than the base metals. Based on these practical advantages, the MPW technology will promote wide potential applications in automobile, marine and aerospace industries for the fabrication of the light structure components.

Yuan Zhang is currently a PhD candidate at Department of Materials Science and Engineering in The Ohio State University. She received her Bachelor degree of Materials Science from Zhejiang University in 2004 and her Master Degrees from Singapore-MIT Alliance on Manufacturing Technology in 2005 and The Ohio State University on Materials Science in 2007. She has received the Zhu Ken Zhen Fellowship from Zhejiang University, Singapore-MIT Alliance Fellowship and American Welding Society Fellowship.

Host: Prof. Brad Kinsey, ×1811