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Winter 3-10-2016

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Recommended Citation
Olivia Graeve, James Kelly, and Boyao Zhang, "Consolidation behavior of bulk amorphous glasses and foils: The effect of current on devitrification kinetics" in "Electric Field Assisted Sintering and Related Phenomena Far From Equilibrium", Rishi Raj (University of Colorado at Boulder, USA) Thomas Tsakalakos (Rutgers University, USA) Eds, ECI Symposium Series, (2016). http://dc.engconfintl.org/efa_sintering/41

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CONSOLIDATION BEHAVIOR OF BULK AMORPHOUS GLASSES AND FOILS: THE EFFECT OF CURRENT ON DEVITRIFICATION KINETICS

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Key Words: Amorphous metals, devitrification, consolidation, spark plasma sintering

We present the application of dynamic loading and rapid heating as controlling parameters for the spark plasma sintering of an ultra-high hardness and highly corrosion resistant Fe-based amorphous alloy ($Fe_{49.7}Cr_{17.7}Mn_{1.9}W_{1.6}B_{15.2}C_{3.8}Si_{2.4}$), such that sintering temperature and time can be used as independent variables for devitrification. We develop two types of *in situ* composites using the dynamic loading strategy and characterize the density, phase development, and microstructure. We also develop and characterize *ex situ* composites by adding various crystalline powders to the amorphous metal powders and explore possible effects of particle size, volume fraction, and type of crystalline phase (W or Ta) on the design strategy. From this, we propose a devitrification processing map that facilitates designing *in situ* and *ex situ* BMG composites. *In situ* composites (formed by devitrification) or *ex situ* composites (formed by addition of a reinforcement phase) can facilitate improvement in toughness of these materials. In addition, we will describe the consolidation response of amorphous metal foils of similar compositions as listed above. The samples show unique microstructural features associated with the current flow and sparking in the material during processing.