Effects of Composition and Processing on Microstructure of CuZr Bulk Metallic Glass Composites

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The goal of this work was to examine the effect of the concentration of a high melting point element on the crystallization of a bulk metallic glass-forming alloy. Alloys with compositions (Cu48Zr48Al4)100-xNbX, with x = 0, 0.25, 0.5, 0.75, and 1, were cast from the melt into cylindrical rods of 3 and 4 mm diameter using a Cu mold, and their microstructures were characterized in detail. 4 mm diameter specimens of all compositions were found to be fully crystalline. The results for the 3 mm diameter specimens, which cooled from the melt at a higher quench rate, were inconclusive. Optical and scanning electron microscopy (SEM) observations show at least 3 phases, including at least 2 crystalline phases within a matrix of undetermined structure. X-ray diffraction measurements show peaks for 2 phases; B2 CuZr and CuZr2. SEM observations of the B2 phase were consistent with the expected spherical shape. Compositional measurements obtained via energy dispersive x-ray spectroscopy (EDS) suggest that the second phase may be CuZr2 with aluminum substituted for copper. The observed microstructures were similar for all compositions, indicating that niobium content does not have a significant effect on the microstructural evolution of the alloy.