

Structure formation of phase separated metallic glasses

Dr.Mattern Norbert

IFW Dresden, Institute for Complex Materials, Dresden, Germany

Phase separated metallic glasses can be prepared in some glass-forming alloy systems by adding further elements with large positive enthalpy of mixing to one of the main constituent. Then phase separation may occur in the liquid or in the undercooled liquid, which can be frozen into a phase separated metallic glass by rapid quenching. As examples we will discuss the occurrence of phase separation in four alloy systems:

1. Ni-Nb-Y
2. Zr-Co-Al-Gd
3. Co-Cu-Zr
4. Cu-Zr-Ag

The structure formation upon quenching of such melts is essentially determined by the thermodynamic properties of the liquid phase beside preparation parameters like quenching rate. In order to obtain a phase-separated metallic glass the composition ranges of liquid-liquid decomposition and glass forming ability have to coincide. Then the formed microstructure depends strongly on the chemical composition according to the binodal area in a multicomponent liquid. Early stages of phase separation can be obtained if the temperature of decomposition is close to the glass transition temperature. The evidence of a spinodal mechanism of decomposition is observed in rapidly quenched Zr-Co-Al-Gd glasses as proven by in situ Small-angle X-ray Scattering and Atom Probe Tomography. In an outlook, the assessment of corresponding phase diagrams is pointed out as well as first results on mechanical properties of phase separated metallic glasses.