Liquid-liquid transitions in metallic melts

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Abstract:

Polymorphic transitions are very common in crystalline materials and can be first order transitions like e.g. from austenite to ferrite or second order like in the case of the ordering transition from BCC to B2. Recently polymorphic transitions within the liquid state termed polyamorphisms have been observed or proposed.

In this contribution we present experiments on kinetics [1], thermodynamics and structure of molten Zr41.2Ti13.8Cu12.5Ni10.0Be22.5 (Vit1) in the equilibrium state as well as in the undercooled state. We observe sudden changes of viscosity of 2 orders of magnitude that are associated with a latent heat in the absence of crystalline reflexes under synchrotron radiation. These effects are observed upon cooling and heating and exhibit a pronounced hysteresis.

The results suggest that the liquid alloy undergoes a weak first order phase transformation likely from a short range ordered fragile state at high temperatures to a medium range ordered strong state at low temperatures. This behavior is compared with other Zr-based alloys [2] and discussed in a bigger picture that can be drawn when comparing fragile –strong transitions in different material classes [3].

References:

[1] The influence of shear rate and temperature on the viscosity and fragility of the Zr41.2Ti13.8Cu12.5Ni10.0Be22.5 metallic-glass-forming liquid.
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[2] High temperature melt viscosity and fragile to strong transition in Zr-Cu-Ni-Al-Nb(Ti) and Cu47Ti34Zr11Ni8 bulk metallic glass
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[3] Glass transition with decreasing correlation length during cooling of Fe50Co50 superlattice and strong liquids.
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