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The short-range order in Zr-Ti melts

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The early transition metals Zirconium and Titanium show very similar chemical and structural properties. Alloyed they compose a completely miscible system, which is the boundary binary system for many bulk metallic glasses (BMGs) and stable quasi-crystals. However, the detailed formation mechanisms of these special structures remain largely unknown and are often speculative. Here, accurate knowledge of melt properties is essential. Using electromagnetic levitation (EML), we are able to process the chemical highly reactive Zr-Ti melts over a large temperature range and glean information of the liquid. In-situ neutron diffraction shows that barely any chemical short-range order (CSRO) is present and the melt structure is dominated by topological packing. Measurements of the self-diffusivity using quasi-elastic neutron scattering (QENS) show a concentration dependent motion of Ti-atoms in the melt. We calculate the liquid dynamics using the Mode-Coupling Theory (MCT), which predicts the dynamics from the static structure in dense fluids. The results are qualitative very similar to our QENS measurements, which indicate that the topological short-range order indeed dominates a considerable impact on the atomic motion. We show that this interplay can accurately be described using MCT, which will contribute to a comprehensive understanding how short-range order affects the quasicrystal and glass formation.

Summary

Topic

1. Diffusive dynamics

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