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Structural and thermophysical properties of undercooled glass forming CuTi melts

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CuTi-based glass forming alloys feature a large undercooled liquid region and a high glass-forming ability, which makes them interesting materials particularly for biomedical and lightweight applications. However, for the development of alloy compositions with optimized glass-forming abilities, the relevant mechanisms on the atomic scale are still to be explored. For a fundamental understanding of the glass formation processes, regarding the atomic structures and short-range orders in the undercooled melt, binary CuTi serves as a less complex reference system. We studied composition-dependent packing fraction and short-range order in the binary CuTi liquids in the range of 33 to 76 at% Cu by neutron and x-ray diffraction. Due to the high chemical reactivity of Ti-based melts, the CuTi samples have been containerlessly processed using electrostatic levitation. This technique enables access to the metastable regime of an undercooled melt. In addition, the absence of any container or crucible results in an excellent signal-to-noise ratio in scattering experiments. To take full advantage of the different scattering contrasts of the CuTi system, data from neutron scattering and diffraction with synchrotron radiation are combined, which gives information on topological and chemical short-range orders. The atomic structure is brought into correlation with the thermophysical properties such as the melt viscosity, which reflect the dynamic behavior of the system.

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