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Impact of Sulfur on the melt dynamics of glass forming Ti75Ni25–xSx

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Bulk metallic glasses combine a spectrum of favorable mechanical and chemical properties. Especially Titanium-based bulk metallic glasses are demanded for lightweight construction and for medical devices. However, the presence of toxic Beryllium and the limited casting thickness restricts the production of Titanium-based bulk metallic glasses. Recently, Sulfur was recognized as alloying element for bulk metallic glass production. In Ti75Ni25 the substitution of Nickel by Sulfur leads to bulk metallic glass formation for 8 at.% Sulfur.
In order to identify the origin of the enhanced glass forming ability, we examined the melt dynamics of Ti75Ni25-xSx (x = 0, 5, 8) on different length scales [1]. The mean Ti/Ni self-diffusion coefficients were probed by quasielastic neutron scattering on the time-of-flight-spectrometer TOFTOF. Since Titanium-based melts are highly reactive, we applied containerless processing techniques to perform our experiments. We observe a decrease of melt dynamics for both viscosity and self-diffusion upon Sulfur addition. This is accompanied by a decrease of the melt packing fraction. Neither a reduction of the liquidus temperature nor a dense melt packing can explain the enhanced glass forming ability. Apparently, chemical interactions that lead to the development of a complex melt structure are involved.
[1] J. Wilden, F. Yang, D. Holland-Moritz, S. Szabó, W. Lohstroh, B. Bochtler, R. Busch, A. Meyer (2020) Applied Physics Letters, 117(1), 013702.

Primary author: WILDEN, Johanna

Co-authors: YANG, Fan (Deutsches Zentrum für Luft- und Raumfahrt); HOLLAND-MORITZ, Dirk; SZABO, Sandro (Heinz Maier-Leibnitz Center (MLZ) and Physics Department, Technical University of Munich, Lichtenbergstrasse 1, 85748 Garching, Germany); LOHSTROH, Wiebke; BOCHTLER, Benedikt; BUSCH, Ralf; MEYER, Andreas (German Aerospace Center)

Presenter: WILDEN, Johanna

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