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High transmission, low-scattering neutron window material –a glass that is not fragile

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Glassy metals provide an attractive route to low-scattering window materials for neutron instruments and sample environments. These can improve significantly efficiency in use of neutrons. Studies with AMLOY-ZR01, a zirconium based bulk metallic glass from Heraeus have shown high transmission and low levels of small-angle scattering as well as the complete absence of Bragg diffraction peaks [1]. Additive manufacturing is very well suited to low-volume production of specialist components and fully retains the glassy structure. Samples 2.2 mm thick showed neutron transmission of 0.9 to 0.95 for wavelengths between 0.5 and 15 Å. Compared with alternative materials the mechanical properties are attractive: the Youngs modulus measured under compression is about 90 GPa and the stress at break is 1.5 to 1.7 GPa at ambient temperatures. The resilience of the material compared with other low scattering alternatives such as quartz glass, or single crystals of sapphire or silicon is much better. Glassy metals can now be used readily as large mechanical components: the additive manufacturing process retains the fully amorphous structure and keeps materials costs low for complex components. Potential applications for this material have been identified [2] as, for example, vacuum windows for neutron instruments and as components in complex sample environments such as shear cells. Efficiency benefits from high transmission and safety advantages make use of this new material worthwhile. The presentation will show scattering data and other results that identify a wide working range of applications.

1. A. Ericsson, V. Pacheco, J. J. Marattukalam, R. M. Dalgliesh, A. R. Rennie, M. Fisk, M. Sahlberg 'Crystallization of a Zr-based metallic glass produced by laser powder bed fusion and suction casting'J. Non-Crystal. Solids 571, (2021), 120891. https://doi.org/10.1016/j.jnoncrysol.2021.120891
2. Swedish Patent SE 574 674 C2

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