MM 11: Invited Talk Jörg F. Löffler

Time: Tuesday 9:30–10:00 Location: H44

Invited Talk MM 11.1 Tue 9:30 H44

Fast calorimetry: studying phase transitions in slow motion

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Studying the details of phase transitions and metastable phase formation is generally difficult for metallic materials because of their rapid nucleation and growth kinetics. Bulk metallic glasses (BMGs), on the other hand, show very sluggish crystallization kinetics. By applying fast calorimetry to slowly transforming BMG-forming systems at heating and cooling rates of several 10,000 K/s, we are able to determine phase transitions more or less in slow motion. In this way, we can explore novel glass states [1], determine their stochastics of nucleation, and study metastable phase formation. During heating at low temperatures, BMGs generally form metastable crystals that transform into more stable modifications at higher temperatures. The classical interpretation is a direct solid-to-solid transformation, but by fast calorimetry we can show that this transition occurs via metastable melting [2]. Furthermore, while with classical calorimetry it is not possible to sufficiently characterize metastable phases owing to their structural changes upon slow heating, fast calorimetry allows for detailed measurements of their heat capacity and melting temperatures [3]. In this way, we are able to verify the existence of monotropic polymorphism and validate Ostwald's phase rule for many metastable phases. [1] J. E. K. Schawe, J. F. Löffler, Nat. Commun. 10, 1337 (2019). [2] S. Pogatscher et al., Nat. Commun. 7, 11113 (2016). [3] J. E. K. Schawe, J. F. Löffler, Acta Mater. 226, 117630 (2022).