MM 19: Invited talk Löffler

Time: Tuesday 9:30–10:00 Location: BAR 205

Invited Talk MM 19.1 Tue 9:30 BAR 205

Ultrafast calorimetry: studying phase transitions in slow motion — •Jörg F. Löffler — Laboratory of Metal Physics and Technology, Department of Materials, ETH Zurich, Switzerland

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 ultrafast differential scanning calorimetry to slowly transforming BMG-forming systems at heating and cooling rates of up to 10^5 K/s, we are able to determine phase transitions more or less in slow motion. This allows us to discover new phase transition pathways, such as solid-state phase transitions that occur via intermediate melting [1]. An important experimental strategy that can in particular be realized via ultrafast calorimetry is to interrupt rapid cooling after (metastable) phase formation and then to "up-quench" the frozen structure via rapid heating. Via surpassing the metastable-to-stable solid phase transition, the formed metastable phase can thus be fully melted, with the possibility of measuring its thermophysical properties such as temperature and enthalpy of melting [2]. We are thus able to discover hidden transient phases, determine the stochastics of nucleation [3], and construct energy-temperature diagrams for metastable phases, with the final aim of constructing complete metastable phase diagrams.

[1] S. Pogatscher et al., *Nature Comm.* **7**, 11113 (2016).
[2] G. Kurtuldu, K. Shamlaye, J. F. Löffler, *PNAS* **115**, 6128 (2018).
[3] J. E. K. Schawe and J. F. Löffler, *Nature Comm.* **10**, 1337 (2019).