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Publication date:
2023

Document Version
Publisher's PDF, also known as Version of record

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Citation (APA):
Bastos da Silva Fanta, A., König, C. N., Chemin, C., Rezaei, B., Jinschek, J., & Hansen, T. W. (2023). *TEM heating holder for in-situ SEM investigations*. Abstract from 20th International microscopy congress, Busan, Korea, Republic of.

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TEM heating holder for in-situ SEM investigations

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Utilizing the transmitted signal for imaging and orientation mapping of electron transparent samples in the scanning electron microscope (SEM) has been gaining attention as an accessible and versatile alternative to investigate nanocrystalline materials. In particular, the development of the on-axis TKD detector [1] enabling faster orientation mapping, as well as the newest improved on-axis configuration [2] allowing simultaneous acquisition of STEM images makes this platform ideal for exploring TEM-based microstructure characterization approaches. One such possibility is the use of Micro-electro-mechanical-system (MEMS)-based holders for dynamic microstructure characterization. MEMS-heating holders were developed for stable and accurate in-situ transmission electron microscope (TEM) experiments [3] offering fast heating and cooling rates with low specimen drift and minimized infrared radiation. Today, they are widely used for in-situ investigation of thin films, nanoparticles and focused ion beam (FIB) prepared lamellas in a variety of research fields.

In this presentation we will focus on demonstrating the applications of MEMS-based heating holder in combination with TKD to study electron transparent samples in the SEM. We will discuss the advantages and disadvantages of this approach and reveal some of the future requirements to optimize the platform. Finally, we will present further perspectives of such heating systems in the SEM by investigating the effect of heating cycles on the microstructure of additive manufactured steels by quasi-in-situ Electron backscatter diffraction (EBSD) and by following the in-situ conversion of patterned polymer precursors into pyrolytic carbon.

[1] Fundenberger, J. J. *et al. Ultramicroscopy* **161**, 17–22 (2016).

[2] Fanta, A. B. S. *et al. Ultramicroscopy* **206**, 112812 (2019).

[3] Allard, L.F. *et al. Microscopy Research and Technique* **72**, 208-215 (2009).