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Plasma Arc Additive Manufacturing (PLAAM) exhibits high heating and cooling rates during the AM process, resulting in material phenomena such as anisotropy and the formation of metastable phases, which significantly influence the final product's properties. A critical aspect of AM is the layer-wise construction of components, wherein each new layer experiences additional heat input that potentially affects microstructural evolution.

This study focuses on developing a heating setup for a scanning electron microscope (SEM) capable of accurately reproducing the high heating and cooling rates observed during AM on bulk-like samples measuring 100x100x20µm. The devised heating setup relies on a micro-electro-mechanical systems (MEMS) chip, offering precise control over heating and cooling rates, thus closely emulating the conditions experienced in the AM process. To validate the efficacy of the heating setup, COMSOL temperature simulations are employed to ensure accurate thermal control.

The effects of cyclic heating on the microstructure are investigated through electron backscatter diffraction (EBSD) analysis performed after each heating step. This quasi-in situ EBSD study enables the characterization of phase transformations, texture alterations, and grain growth, thereby providing valuable insights into the material behavior under AM-like heating conditions.

This research contributes to the advancement of knowledge and optimization of AM processes, ultimately facilitating the production of high-quality components with customized microstructures and improved performance.