Institute of Materials Science, Joining and Forming
Kopernikusgasse 24/I, 8010 Graz

Announcement of a Master's thesis, 07.01.2026

Residual stress characterization in additively manufactured components

Short description

Additive manufacturing processes, such as laser powder bed fusion (LPBF), offer a high degree of freedom in part design. However, the rapid cooling and complex thermal gradients inherent to LPBF often lead to the development of significant residual stresses in the fabricated components. In the proposed work, residual stresses in complex LPBF parts will be characterized and quantified using state-of-the-art measurement techniques based on high-energy synchrotron X-rays. In particular, two measurement approaches – transmission and conical slit cell (CSC) geometries – will be systematically compared. Based on the experimental findings, LPBF printing strategies will be optimized to mitigate the detrimental effects of residual stresses. Hands-on experiments will be carried out both in the lab at IMAT and at the Deutsches Elektronen-Synchrotron (DESY) in Hamburg, Germany.

Activities include

1. Literature research on X-ray based residual stress characterization, the evolution of residual stresses during LPBF (influence of printing parameters etc.), and the metallurgical basics of the alloy system
2. Definition of suitable specimen geometries and initial printing strategies for further investigation
3. Characterization of LPBF samples at IMAT: density measurements, microscopy incl. specimen preparation, light-optical and scanning electron microscopy, hardness mappings, mechanical properties
4. Characterization of LPBF samples using high-energy X-rays (supervised by colleagues at DESY): basic material characterization using high-energy X-ray diffraction (HEXRD), residual stress characterization in a transmission setup as well as in a CSC setup, strain mappings
5. Interpretation of the results, optimization of the printing strategy, verification of the proposed approaches
6. Documentation, preparation of the Master's thesis (English or German), and >1 publication (article/poster)

Organization

Supervisor: Ass.Prof. Dipl.-Ing. Dr.mont. Petra Spörk-Erdely, petra.spoerk-erdely@tugraz.at.

Duration: Min. 6 months, start as of now

Location: IMAT, Materials Group, Kopernikusgasse 24/I, 8010 Graz, and outstation of the Helmholtz-Zentrum Hereon at the Deutsches Elektronen Synchrotron (DESY) in Hamburg, Germany, for 1–3 hands-on beamtimes at the high-energy materials science beamline P07 (a few days each)

Funding: Employment as a project assistant at IMAT ("geringfügige Anstellung") plus travel expenses

Requirements: Basic knowledge in materials science (master programs Mechanical Engineering, Advanced Materials Science, (Technical) Physics, or (Technical) Chemistry)

Further information

For further information, please contact the secretariat of the institute or the supervisor:
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