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Defect evolution in additively manufactured components with neutron grating interferometry (nGI)

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Additive manufacturing (AM) has become increasingly popular in different applications where complicated geometries, weight reduction, and customized performance are desired. The additive nature of manufacturing provides an edge over conventional manufacturing processes regarding complex shapes, customized designs, and depositions. Internal defects like lack of fusion (LOF), cracks, and voids are major problems contributing to the part failure of additively manufactured parts. Tensile residual stress (TRS) developed due to high-temperature gradients and defects also affects the performance of the fabricated parts. It was found LOF defects can only be detected by neutron grating interferometry (nGI). nGI in ICON beamline, PSI is used to study the in-situ defect evolution of additively manufactured IN718 materials under tensile loading using FRM II tensile rig. Defect growth and crack growth propagation are also analyzed using nGI tomography to gather 3D information on the crack propagation zone. Microstructural analysis, defect, crack growth, and fractography study are also performed using destructive classical techniques such as optical microscopy and SEM, to complement the nGI non-destructive testing.

Primary authors: Prof. SAHLBERG, Martin (Department of Chemistry - Ångström Laboratory; Inorganic Chemistry, Uppsala University); SCHULZ, Michael; PANT, Prabhat (Uppsala University/MLZ); SINGH, Sapam Ningthemba (FRM II, Technical University of Munich); SEBOLD, Simon (MLZ); NEUWIRTH, Tobias; WASMUTH, Uwe

Presenter: SINGH, Sapam Ningthemba (FRM II, Technical University of Munich)

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