

Neutron research, Contr. talk 1 - Residual stress and heat treatment studies of additively manufactured stainless steel by neutron imaging and diffraction

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One of the biggest limitations of parts made by Selective Laser Melting (SLM) is the high tensile residual stresses that accumulate in the near-surface region. They are known to have a detrimental effect on mechanical properties and can even cause SLM process failure. Therefore, it is always needing to be applied additional heat treatment operations to relieve stress or shock peening to convert the tensile stress to the compressive stresses. Without the knowledge of residual stress in the material, it is not possible to estimate the service life or ensure the integrity of machine parts. Among various experimental techniques, only neutron and high-energy synchrotron X-ray techniques allow us to accurately measure the deep internal stress in large metallic samples with all stress components nondestructively. In this talk, we will discuss how neutron techniques are important for additive manufacturing or metallic materials research in general and present some of our residual stress characterization work performed on SLM build stainless steel which utilized both standard neutron diffraction and neutron Bragg edge imaging to investigate the effect of Hot Isostatic Pressing (HIP) temperature and heat treatment to the residual stress.

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