Bulk Texture Measurements with the Neutron Time-of-Flight Diffractometer HIPPO

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Neutrons offer the ability to penetrate centimeters of materials. In conjunction with beam spots on the order of a cm^2, neutrons offer the ability to characterize bulk materials without the need for sample preparation. In many cases, deformation specimen, drill cores, or annealing samples can be measured as-is. Micro-structural parameters quantified by neutron diffraction include texture and volume fractions. Neutron diffraction therefore complements surface-sensitive techniques such as electron or X-ray diffraction. The HIPPO instrument recently celebrated 15 years of operation at the short-pulse neutron spallation source at LANSCE. With the cessation of the user program in 2014, in recent years predominately programmatic research was conducted on HIPPO. In this presentation we provide the basics of neutron time-of-flight texture measurements and give examples of the texture research of the past few years.

Investigating microstructure in additively manufactured Ti-6Al-4V, texture was measured as a function of location as well as the texture evolution during annealing, studied by in-situ high temperature texture measurements, on samples produced by electron beam melting and selective laser melting. A novel capability are semi-spatially resolved texture measurements, characterizing the microstructure in slices of a longer sample. This was applied to additively manufactured steel samples deformed in Taylor-tests with a gas gun. The spatially resolved characterization of ferrite, austenite and epsilon-Fe with neutrons allowed to identify regions with the highest volume fraction of epsilon-Fe, which were subsequently characterized destructively by EBSD. Complementing energy-resolved neutron imaging, spatially resolved neutron texture measurements characterized accident tolerant U-N/U-Si nuclear fuels prior to insertion into the Advanced Test Reactor at Idaho National Laboratory for irradiation tests. The texture evolution during the compaction of triclinic TATB high-explosive crystals is relevant to modeling efforts of the bulk properties of this highly anisotropic material. Time-of-flight neutrons, covering a large d-spacing range, allow to measure the texture of this material that does not provide a single, well-resolved peak for conventional pole figure texture measurements. Finally, spatially-resolved texture measurements on a uranium hemi-sphere allowed to investigate thermal residual stresses for the highly anisotropic uranium, shrinking along the orthorhombic *b*-axis during heating while expanding along the *a*- and *c*-axes, in such components.