HIDRA

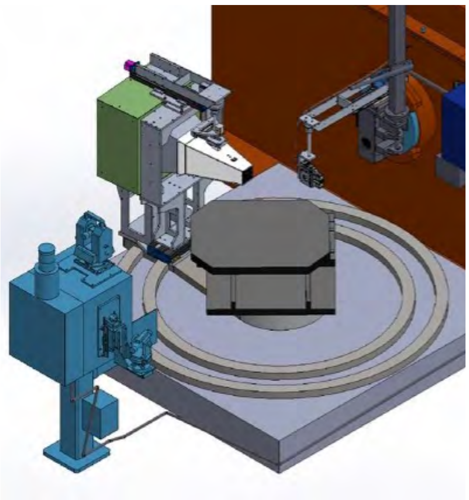
High Intensity Diffractometer for Residual stress Analysis

High Flux Isotope Reactor

BEAMLINE

HB-2B

The High Intensity Diffractometer for Residual stress Analysis (HIDRA), located at beam port HB-2B, is a high-flux engineering diffractometer ideal for spatial characterization of residual stress in large-scale engineering components. The instrument is flexible, meaning its configuration is defined by the sample material and geometry. The large-specimen "XYZ" sample translation stage is designed for spatial scanning of strains at depths from sub-millimeters to centimeters. The high flux and large detector coverage allow real-time, in situ studies or high-resolution mapping. Ancillary equipment available for use at HIDRA a Huber Eulerian cradle, and high-temperature furnaces (vacuum or air). Load frame experiments are currently discouraged on HIDRA given the superior load frame capabilities at VULCAN. Custom-built sample environment systems can be installed on the XYZ sample positioning system. A cuboid software tool is available to plan experiments and establish measurement locations in the sample coordinate system, reducing neutron beam time needed for alignment and increasing the accuracy of mapping measurements. Slits are preferred when a sample can be placed near the diffracted snout, for larger samples a radial collimator is preferred.



Newest Revision of the Instrument showing the 2D detector with incident and diffracted optics.

APPLICATIONS

The penetrating power of neutrons is useful in mapping residual stresses in engineering materials. HIDRA is used for strain mapping of heat-treated samples, forgings, extrusions, bearings and races, fasteners, components for transportation and aerospace, pressure vessels and piping, nuclear engineering components, and parts made through additive manufacturing. Neutron diffraction studies of materials under applied stress reveal phase- and grain- level knowledge of deformation processes, which are fundamental for developing finite-element and self-consistent field models of materials behavior. More complex experiments have included functional materials such as piezoelectric materials in applied fields, and shape-memory alloys under varying load and temperature conditions.

SPECIFICATIONS

Beam spectrum	Thermal
Monochromator takeoff angle	88° (fixed), λ= 1.452 Å (Si 511); 1.452 Å (Si 333); 1.540 Å (Si 422); 1.731 Å (Si 331); 1.886 Å (Si 400); 2.275 Å (Si 311); 2.667 Å (Si 220)
Flux on sample	3×10^7 n/cm^2/s (Si 331 and Si 400)
Detector angle range	70–110° optimal
Detection system	30x30 cm 2D Denex
2D Detector Coverage	17° 2θ
Z translation	Z ± 250 mm 39 cm table to beam height
Nominal gage volume	Slits: Width: 0.3–5 mm; Height: 0.3–2 mm Radial Collimator: Width: 3 mm
Peak location precision	0.003° 2Θ
Sample environments	• Huber Eulerian cradle and/or phi-chi stage for tensor and texture • Vacuum and environmental furnaces • CrESL creep electrostatic levitator • Integration with flexible specialized sample environments
Max. Sample Size	Weight Limit: 50kg Dimensions: consult with team

21-G02330/jdh Dec 2021

For more information, contact

Jeffrey Bunn, bunnjr@ornl.gov, 865.574.6332

neutrons.ornl.gov/hidra

Oak Ridge National Laboratory

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