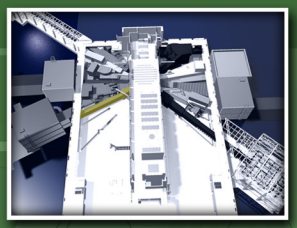
Spallation Neutron Source

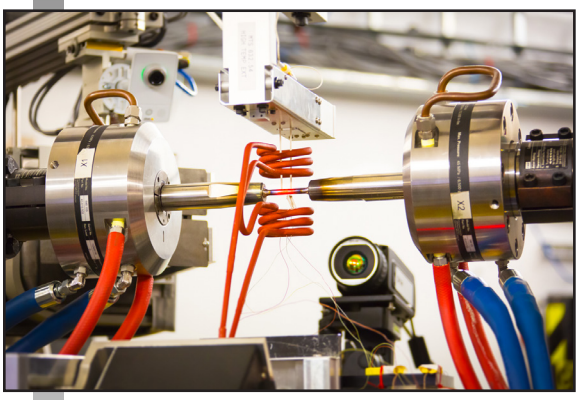
Instrument

Beam line 7



Vulcan – Engineering Materials Diffractometer

VULCAN is designed to tackle a variety of problems in materials science and engineering, including deformation, phase transformation, residual stress, texture, and microstructure studies. VULCAN provides rapid volumetric mapping with a sampling volume of 1 mm^3 and a measurement time of minutes for common engineering materials. In extreme cases, VULCAN has the ability to study kinetic behaviors in sub-second times. Through these measurements, VULCAN can help scientists and engineers predict the reliability of structural components and better understand how materials behave under extreme conditions. A small-angle detector will be installed in the near future to provide SANS capability. This will allow users to conduct fast, simultaneous measurements using small-angle scattering, opening new research opportunities for the study of structure evolution at multiple length scales. Available sample environments and equipment include a unique load frame capable of multi-axial loading and fatigue tests with an induction heater that heats to 1273 K, a high-temperature vacuum furnace that heats to 1873 K, a controlled atmosphere furnace that heats to 1773 K, a battery cycler, a high-voltage ac/dc field, and standard equipment from the sample environment group. VULCAN is also equipped with laser trackers and an SScanSS alignment system for quick sample mounting.



Applications

VULCAN covers a broad range of applications in materials science and engineering, from residual stress determination in engineering components to understanding the fundamental aspects of material behaviors during synthesis, processing, and service. Research areas that VULCAN can benefit include but are not limited to the following:

- In situ studies of materials behavior during processing: phase formation, temperature distribution, texture changes, stress development, precipitation.
- In situ loading studies of crystalline/amorphous materials at high temperatures: phase transformation, fatigue damage, deformation in nanostructured materials, creep behaviors, piezoelectric and shape-memory alloys.
- Residual stress and microstructure changes in engineering components.
- Phase transformation/transition kinetics during material synthesis.

Specifications

Sample-to-detector distance	~2 m
Scattering angles	V: ±15° H: 79° to 101°
Wavelength bandwidth/ *d*-spacing band (Å)	~1.44 at 60 Hz d: 0.5-1.5 ~2.88 at 30 Hz d: 0.5-2.5 ~4.32 at 20 Hz d: 0.5-3.6
Resolution	~0.25% in high-resolution mode ~0.45% in high-intensity mode
Flux on sample ($n/s/cm^2$) at 60 Hz	2.2×10^7 in high-resolution mode 6.7×10^7 in high-intensity mode
Gauge volume (mm^3)	Strain/phase mapping: 8–20 in situ loading and/ or heating: 100–250
Beam size	Incident slit: 2–12 mm in horizontal direction, 2–12 mm in vertical direction
Beam divergence	Horizontal: 0.2° under HR 0.6° under HI, vertical: 1.6°
Receiving collimators	2 or 5 mm

Status: Available to users

For more information, contact

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