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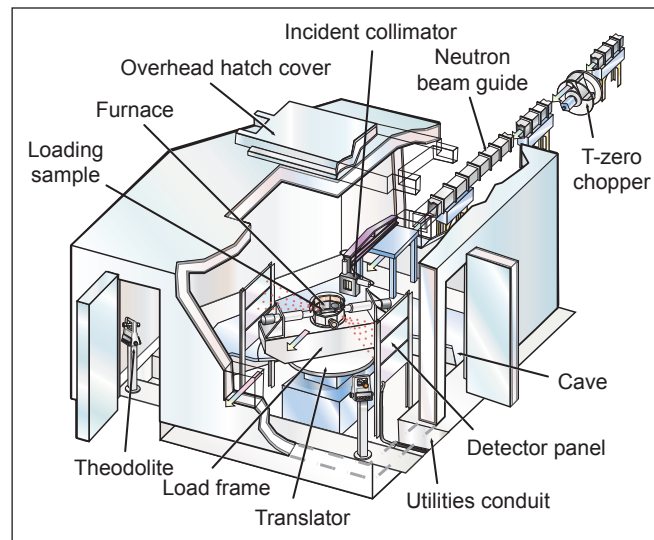
Spectrometer for Materials Research at Temperature and Stress (SMARTS)

The SMARTS is a third-generation neutron diffractometer optimized for the study of engineering materials. It was funded by DOE and constructed at the Lujan Center, coming on line in the summer of 2001. SMARTS provides an exciting range of capabilities for studying polycrystalline materials focusing on two areas: the measurement of deformation under stress and extreme temperature, and the measurement of spatially resolved strain fields. The underpinning technique is neutron diffraction, which has been used to study engineering structural materials since the early 1980s.

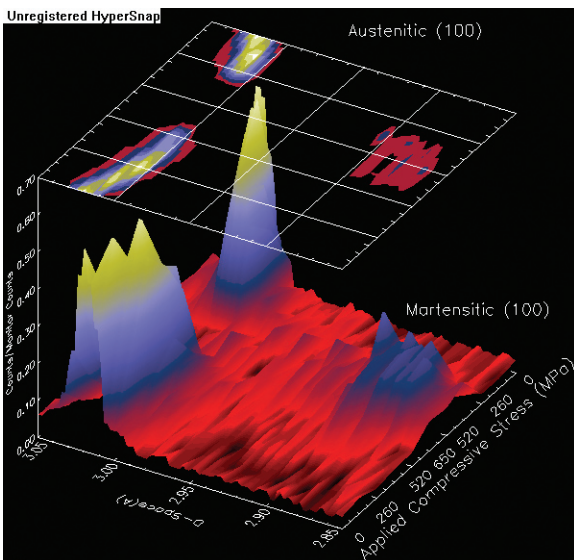
SMARTS expands the application base of neutron diffraction to a wider range of engineering problems

than previously possible. With an extensive array of *in situ* capabilities for sample environments, it enables measurements on small (1 mm³) or large (1 m³) samples. Components with dimensions up to 1 m and up to 1,500 kg can be positioned precisely in the beam. Permanently mounted alignment theodolites provide a simple and efficient way to position samples or equipment to within 0.01 mm.

The furnace and load frame suite allows research on materials under extreme loads (250 kN) and at extreme temperatures (1,500°C). *In situ* uniaxial loading on samples up to 1 cm in diameter at stresses of 2 GPa and with lower stresses at temperatures up to 1,500°C are routine.



"Short" radial collimator supported between load frame and detector.



Development of diffraction pattern during stress-induced phase transformation in super-elastic nickel titanium.

Specifications	
Performance	
Moderator	Chilled H ₂ O, high resolution
Resolution at 90° (wavelength dependent)	~0.4%
d-spacing range	~0.5–4 Å
Nominal time for 1 cm ³ under load at temperature	~10 minutes
Nominal time for 1 mm ³ in 10-mm-thick Fe plate	~60 minutes
Primary Flight Path	
Moderator to sample	~31.0 m
Incident collimation (at sample)	1–625 mm ²
Secondary Flight Path	
Sample to 90° tube	~1.5 m
2θ angle subtended (each 90° bank)	~30°
Load-Frame Furnace	
Maximum uniaxial force (compression or tension)	250 kN
Actuator motion	0.15 m
Furnace maximum temperature—under load	1,500°C
Furnace maximum temperature—stand alone	1,800°C
Specimen geometries	Threaded tensile/Cylinder compression
Translator	
Capacity	1,500 kg
Motions	X = 0.3 m, Y = 0.3 m, Z = 0.6 m, R = 370°
Radial Collimators	
2θ angled subtended	20°
Spatial resolution parallel to beam	1, 2, 3, 4, 5 mm