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Rotatable load frames for neutron diffraction – analysis of strain, texture, phase transformations and elastic constants

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We present unique load frames which allow an orientation of the load axis by an Eulerian cradle type design and examples of their applications. One version is optimized for texture analysis allowing a free sample rotation around the phi axis under uniaxial tension or compressive stress. Thus complete pole figures under mechanical load can be derived. A second version enables torsion in addition to tension or compression. The load frames were designed at MLZ for the diffractometers SPODI and STRESS-SPEC. However, their compact design allows a usage also on other neutron or synchrotron facilities.

In addition to layout and specifications we present selected examples:

- Intensity and strain pole figures in austenitic stainless steels were derived under mechanical load, elucidating the orientation distribution of crystallites as well as lattice strains in one experiment.
- Single-crystalline elastic constants in polycrystalline steels and Ti alloys could be determined under a defined mechanical stress in a method which can be regarded as a reverse of classical stress analysis.
- In monoclinic NiTi shape memory alloys the contributions of domain switching and lattice strains to the macroscopic strain were determined under mechanical load.
- The evolution of martensite variants in polycrystalline NiMnGa under thermo-mechanical load was investigated.

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