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In-situ neutron diffraction studies on micro- and macrostrains in Ni-base superalloys

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Polycrystalline Ni-base superalloys are frequently used materials for high-temperature applications like turbine discs. To get a deep knowledge of the precipitation kinetics during the thermomechanical production process and under service conditions, a new testing machine is built at the Research Neutron Source (FRM II) at MLZ in Germany to perform tension and compression loading up to 100 kN at temperatures up to 1200 °C in the neutron beam. In this contribution, results on in-situ tensile tests are presented that were performed on bulk samples of polycrystalline Ni-base superalloys at temperatures up to 600 °C at the STRESS-SPEC neutron diffractometer. In-situ neutron diffraction enabled to identify the fraction of the existing phases and their lattice parameters depending on mechanical and thermal loading. In particular, it was possible to determine the change in the preferred crystallographic orientation and the defect density in various phases in the elastic and plastic deformation regime.

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