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In-situ neutron diffraction and electron microscopy to study deformation mechanisms in Ni-based superalloys

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The polycrystalline Ni-based superalloy VDM Alloy 780 is a further development of the Alloy 718, which is limited to around 650 °C in the operation temperature of gas turbines. The main differences between these two alloys are essentially the replacement of Fe by Co and a higher Al content in combination with a lower Ti content in VDM Alloy 780. Tensile loading and unloading experiments were carried out with a newly developed testing machine on the STRESS-SPEC instrument of MLZ to examine the deformation behavior at 25 and 500 °C. In addition, a detailed microstructural study using electron microscopy was performed before and after the test to correlate the macroscopic mechanical properties with micromechanical deformation behavior in various oriented grains. The deformation behavior, which is mainly dislocation motion and shearing of the Gamma Prime precipitates, does not change at this temperature range. The deformation is strongly anisotropic and depends on the grain orientation.

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