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In situ neutron diffraction during tensile loading of oxide dispersion strengthened steels: effect of the material microstructure

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Ferritic oxide dispersion strengthened (ODS) steels are considered as candidate materials for fuel claddings in Generation IV nuclear energy systems. Amongst their prerequisite properties, ODS steels have to retain their dimensional stability over the operating conditions targeted for this next generation of nuclear reactors. Mechanical testing is thus necessary to ascertain that these materials comply with the requirements of the nuclear safety specifications. The aims of the present work are thus to determine (i) the tensile properties of two ODS steels with distinct microstructure and (ii) the effect of the anisotropy of the grain microstructure on their microscopic mechanical properties. In situ neutron diffraction during tensile loading has been carried out at POLDI. During deformation, the evolution of the lattice strain has been derived through the profile analysis of several Bragg diffraction peaks. Post-deformation fractography and microstructural studies have been performed using SEM and TEM. A deeper insight into the interplay microstructure / mechanical properties has been obtained. This is crucial for the design optimization of such nuclear-energy related materials.

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