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Improving our fundamental understanding of novel superalloys by neutron scattering and diffraction

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Superalloys are key materials of our modern society. They are not only used in harsh environments of power plants for energy conversion but also in aerospace or marine applications, as they combine excellent mechanical properties at high homologous temperatures with very good oxidation and corrosion resistance. To further improve the efficiency of engines, advanced superalloys with improved properties are needed that can operate at higher temperatures.
In this work, examples of new Ni- and Co-based superalloys are presented whose development and characterization was supported by neutron as well as X-ray diffraction and scattering methods. Results on the temperature-dependent lattice misfit between the main constituent phases of the investigated superalloys explains the observed precipitate morphologies and are used for calculating the force balance of interfacial dislocations. In-situ high-energy X-ray diffraction measurements revealed the deformation behaviour and formation of unwanted intermetallics phases during high temperature deformation. Finally, small angle neutron scattering results could be used to adjust the alloys'heat treatments to optimize their mechanical properties.

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