Contribution ID: **179** Type: **Poster**

Optimizing the microstructure of compositionally complex CoNiCr-base superalloys for enhanced high temperatures strength

Tuesday, 21 March 2023 16:00 (2 hours)

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 significantly higher temperatures. Newly developed Co-based superalloys seem to be interesting candidates for new high-temperature materials.
In this work, Co-based superalloys are presented whose development and characterization was supported by neutron scattering methods. It will be shown how neutron diffraction on simple, coarse grained experimental Co/Ni-Al-W-X alloys helped to determine the temperature-dependent lattice misfit between the main constituent phases and how small angle neutron scattering investigations on compositionally complex polycrystalline CoNiCr-base superalloys could be used to adjust the heat treatments to optimize their mechanical properties. Various microstructures after different heat treatments were analyzed by scanning and transmission electron microscopy and especially in-situ small-angle neutron scattering during heat treatment experiments. The corresponding mechanical properties were determined by compression tests and hardness measurements. From this, an optimum precipitate size was determined that is adjusted mainly in the first precipitation heat treatment step. This is discussed on the basis of the theory of shearing of precipitates by weak and strong pair-couplings of dislocations. A second age hardening step leads to a further increase in the volume fraction above 60% and the formation of tertiary precipitates in the matrix channels, resulting in an increased hardness and yield strength. A comparison between two different three-step heat treatments revealed an significant increase in strength for the optimized heat treatment.

Primary author: Mr NAGEL, Oliver (Friedrich-Alexander-Universität Erlangen-Nürnberg)

Co-authors: HAUSMANN, Daniel; SOLIS, Cecilia; HEINEMANN, Andre (Hereon); Prof. GÖKEN, Mathias (Friedrich-Alexander-Universität Erlangen-Nürnberg); GILLES, Ralph; NEUMEIER, Steffen (Friedrich-Alexander-Universität (FAU) Erlangen-Nürnberg)

Presenter: Mr NAGEL, Oliver (Friedrich-Alexander-Universität Erlangen-Nürnberg)

Session Classification: Poster session TUESDAY

Track Classification: Engineering applications