Contribution ID: **122** Type: **Poster**

Advancing the Fundamental Understanding of Novel Superalloys through Neutron and Synchrotron Radiation Studies

Tuesday, 5 December 2023 14:00 (3 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 or in even harsher environments of hydrogen-contaning fuels.
In this work, examples of Ni- and Co-based superalloys are presented whose development and characterization was supported by neutron and high energy X-ray diffraction and scattering methods. It will be shown, for example, how in-situ high energy X-ray diffraction measurements revealed the deformation behaviour and formation of unwanted intermetallics phases during high temperature deformation, how small angle neutron scattering results could be used to adjust the alloys'heat treatments to optimize their mechanical properties and how neutron and X-ray diffraction helps to understand the effect of hydrogen on these superalloys.

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Session Classification: Poster Session

Track Classification: Material Science