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Influence of hydrogen on the γ-matrix lattice parameters of a Ni-based superalloy - a diffraction study

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Hydrogen will play a significant role as an energy source and carrier. However, many material-related issues are yet to be clarified to successfully enable a hydrogen-ready energy infrastructure. In particular, hydrogen embrittlement of high-performance alloys is a well-known issue, which is still not entirely understood. Within this talk, the hydrogen embrittlement behaviour of the newly developed Ni-based superalloy VDM® Alloy 780 is discussed. An emphasis is set to understand the impact of hydrogen at the atomiclevel of the alloy. Therefore, specimens were charged electrochemically with hydrogen and subsequently characterized by synchrotron X-ray diffraction (XRD). The incorporation of hydrogen at interstitial sites of the crystal lattice leads to a slight increase of the lattice parameters as compared to hydrogen-free analogues. In-situ XRD measurements show converging lattice parameters of the charged and hydrogen-free samples at elevated temperatures. This indicates a reversibility of the hydrogen uptake by diffusion and subsequent effusion. Hot gas extraction measurements to quantify hydrogen concentrations within the alloys complement the diffraction data. Temperature-dependent hydrogen quantification suggests increasing diffusion rates of hydrogen with rising temperature, corroborating the findings of the XRD investigation. Additionally, tensile tests were conducted to quantify the influence of hydrogen on the alloy during deformation.

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