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Neutron and synchrotron diffraction studies to understand the mechanism and the influence of hydrogen on the microstructure of superalloys.

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Hydrogen will play a major role as a renewable and carbon-free energy carrier. This accordingly also requires the investigation of materials coming in contact with hydrogen in energy conversion devices, e.g. gas turbines. However, such materials, usually nickel-based superalloys, suffer in strength and durability through the so-called hydrogen embrittlement (HE) which is yet to be fully understood. Especially, crystallographic studies of embrittled samples are yet scarcely carried out. Here, the influence of different hydrogen treated advanced alloys such as Alloy X or the newly developed VDM® Alloy 780 is investigated. The alloys are hydrogen loaded electrochemically or via high pressure and high temperature treatments. These samples are subsequently investigated by neutron and high-energy X-ray diffraction and supported by microscopic investigations and mechanical testings. Depending on the loading method, cell parameter reductions or cell parameter expansions are observed because of ordering effects or the incorporation of hydrogen in interstitial sites of the fcc lattice.

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