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In-situ characterisation of the newly developed VDM® Alloy 780 via x-ray diffraction using synchrotron radiation

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The new VDM® Alloy 780 is a Ni-based superalloy developed for higher service temperatures than the widely used alloy 718, consisting of γ matrix, γ´ hardening phase, and δ & η high-temperature phases. Depending on the respective heat treatment of VDM® Alloy 780, various microstructures with different phase proportions can be obtained, which determine the mechanical properties of the alloy over the entire application temperatures.
Via in-situ x-ray diffraction measurements at elevated temperatures, the dissolution of both the γ´ hardening phase and the high-temperature phases can be directly tracked, enabling to determine their solvus temperatures. Also, directly accessible from the measurements is the lattice misfit, i.e. the relative difference of lattice parameters of γ matrix and γ´ hardening phase, and its evolution with temperature which is decisive for the mechanical properties of the alloy and the morphology of the precipitates.
Due to the higher time resolution at the synchrotron, the obtained solvus temperature values are more accurate as previously published by neutron diffraction. However, neutron measurements have much better particle statistics due to the larger measured volume and an enlarged separation of peaks at high theta angles, corroborating the synergistic effect of combining both techniques. Therefore, the synchrotron diffraction data is analyzed comparatively to the existing neutron data.

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