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In-situ high temperature precipitation study in new alloy VDM 780 using SANS

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The new Ni-based superalloy VDM 780, developed for high temperature applications that require good mechanical properties (as gas turbines), shows the presence of only γ' hardening precipitates. The absence of the instable γ'' hardening phase, which transforms into δ phase at 650 °C resulting in a loss of creep resistance, will allow its use at higher operation temperatures. Due to the direct industrial application of this material, a thorough study of the precipitation process under various heat treatments in this alloy will be fundamental for further improvement of the material.

The precipitation behavior of the VDM 780 Ni-base superalloy was investigated by small angle neutron scattering (SANS) at high temperature. Atom probe tomography (APT) measurements were performed in order to obtain the real composition of the matrix and the precipitates that will allow the calculation of the scattering contrast between them. Two different samples with different heat treatment were used in order to obtain materials at different precipitation steps. SANS allowed to monitor the formation of nano-precipitates and their evolution with temperature. It was found that after the first precipitation step at 720 °C, the second precipitation step at 620 °C produces almost no new precipitates. A sample in a final precipitation state measured at the expected operation temperature of 750 °C shows its stability with almost no precipitate growth.

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