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Studies on VDM alloy 780 Premium with standard heat treatments using synchrotron radiation

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Alloy 718 has been widely used in gas turbine and related applications due to its good mechanical properties and structural stability at elevated temperatures (650 °C). The operation temperature of the alloy 718 is limited because of the transformation of the metastable strengthening γ'' phase to stable δ phase at high temperature. A new 718-type Ni-Co based superalloy VDM 780 Premium was developed for higher temperature application. In comparison to alloy 718, the main composition change in VDM 780 is essential replacement of Fe by about 25% Co and a higher Al content in combination with a lower Ti content.

Synchrotron measurements were performed on bulk samples of VDM 780 Premium with standard heat treatment, i.e. the solution heat treated at 980 °C/1.5 h + 720 °C/8 h/FC + 620 °C/8 h/AC. The diffraction patterns were taken (a) during heating and cooling down after 0.5 at the highest T (1040 °C) and (b) during heating and at different holding temperatures (at 970,980 and 990 and 1020,1030 and 1040 °C). The Rietveld refinement of the measured diffraction patterns allowed (1) the identification of all phases present in the sample, γ matrix, γ' hardening phase, NbC and δ and η high temperature phases; (2) the evolution of the cell parameters and misfit with temperature, and (3) solvus and precipitation temperatures determination.

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