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Optimising the gamma/gamma' microstructure and increasing the high temperature strength of a Co-base superalloy

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The newly developed polycrystalline Co-base-superalloy CoWAlloy2 (Co41Ni32Cr12Al9W5 + Ti,Ta,Si,C,B,Zr,Hf) provides a high potential for application as wrought alloy due to the large gap between solidus and gamma'-solvus temperature along with a high gamma'-volume fraction. The scope of this study was the improvement of the high temperature strength by optimizing the gamma/gamma'-microstructure and adjusting different annealing steps.
The microstructure and mechanical properties were investigated by scanning electron microscopy (SEM), transmission electron microscopy (TEM), compression and hardness tests. In-situ high temperature small angle neutron scattering (SANS) at FRMII helped to understand the microstructural evolution during heat treatment. The size of the gamma'-particles increases with increasing annealing time and temperature of the first annealing step. As a result, the hardness of the alloy increases until a maximum after 4 h annealing is reached. The reason is an optimum gamma'-particle size, which can be explained by the weak and strong pair-coupling model of dislocations. A second annealing step leads to a further increase of yield strength due to an increasing gamma'-fraction.

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