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Phase transformations in CoRe-based alloys with Cr and Ni addition studied by in-situ neutron diffraction

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Like other Co-based superalloys presently used in gas turbine static components, the Co-Re alloys use Cr to provide oxidation resistance [1]. Cr addition above 20 at.%, however, pose a challenge –namely the formation of topologically closed packed Cr2Re3-type σ-phase. It is generally avoided in high-temperature alloys as its presence causes brittleness. To improving oxidation resistance and, simultaneously, suppression of σ-phase, the alloys with a partial replacement of Cr by Ni are investigated. In-situ neutron diffraction measurements were performed during heating up to 1450℃ and cooling for a various Ni (8, 15 and 25 at.%) and Cr (18 and 23 at.%) content alloys to study the allotropic transformation of the Co-matrix and the evolution of the low-temperature hexagonal and high-temperature cubic Co phases. Influence of the preparation technique to the initial phase composition was also investigated. The phase evolution was monitored, and an appearance of the secondary fcc phase [2] could be linked to the formation of the σ phase associated with a compositional change in the matrix. The σ-phase formation and its influence on the matrix phase separation –two fcc/hcp phases –in Co-Re-Cr-Ni alloys are an important discovery for the Co-Re alloy development and deserve further investigation.

[1] T. Depka, PhD thesis, Ruhr Universität Bochum, Germany, 2012.
[2] P. Beran, D. Mukherji, P. Strunz, R. Gilles, M. Hölzel, J. Rösler, Adv. Mat. Sci. Eng., 2018, 5410871

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