# Effect of precipitation annealing on mechanical properties of CoCrFeNi based complex concentrated alloys with Al and Ti additions

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## ABSTRACT

Complex concentrated alloys with nominal composition $CoCrFeNiAl_{0.35}$ and $CoCrFeNi(Al,Ti)_{0.35}$ (in molar fraction) were prepared by vacuum induction melting in a ceramic crucible and tilt casting into a cylindrical ceramic mould. As-cast ingots were subjected to the solution annealing and multi-step hot forging followed by recrystallization annealing with the aim to achieve evenly distributed equiaxed grains. The evolution of precipitation hardening of FCC(A1) matrix by secondary phase particles was studied at the temperatures from 700 to 1000 °C for 2 up to 1000 hrs. Microhardness measurements indicated the highest level of precipitation hardening during annealing at the temperature of 700 °C in $CoCrFeNiAl_{0.35}$ alloy and 750 °C in $CoCrFeNi(Al,Ti)_{0.35}$. In $CoCrFeNi(Al,Ti)_{0.35}$ alloy annealed at 700 - 800 °C formation of $L1_2$ nanoprecipitates inside the grains was revealed by TEM and discontinuously precipitated phases enriched by Al, Ni and Ti were observed on the grain boundaries. In $CoCrFeNiAl_{0.35}$ alloy BCC(B2) particles are formed in the studied temperature range and $L1_2$ nanoprecipitates were observed only after annealing at 700 °C. The effect of annealing time at 750 °C of $CoCrFeNi(Al,Ti)_{0.35}$ alloy on tensile properties was investigated. Relation between discontinuous precipitation and fracture mode was elucidated. Tensile properties of studied alloys after precipitation annealing at 700 and 900 °C were compared. Product of strength and elongation in tested precipitation strengthened $CoCrFeNi(Al,Ti)_{0.35}$ samples reached the value between 38 and 45 GPa, while in $CoCrFeNiAl_{0.35}$ samples only 19.6 GPa.

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## BIOGRAPHY

Dr. Alena Klimová has her expertise in providing experiments and developing methodologies related to heat treatment of materials, solidification, qualitative and quantitative evaluation of microstructure, chemical composition and testing of materials. The object of her interest is research of materials for high-temperature applications and high entropy alloys with resistance to hydrogen embrittlement.

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