

Formation of coating on high-entropy FeCoCrNiAl alloy during annealing

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The study of phase transitions in cast high-entropy FeCoCrNiAl alloy using high-temperature (HT) *in situ* X-Ray diffraction in temperature range 293 – 1273 K in a helium atmosphere (fig. 1). In initial state this alloy is a single-phase solid solution on the basis of the BCC structure, ordered according to B2 type. In the temperature range 473 – 873 K changes phase composition is not observed. However, fixed increase in the period of the phase ordered with the B2-type structure, which is associated with the thermal expansion of lattice.

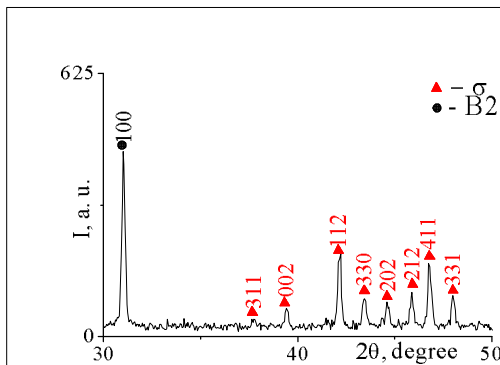


Fig. 1. High-temperature *in situ* XRD patterns of multicomponent FeCoCrNiAl alloy in a helium atmosphere at 1073 K

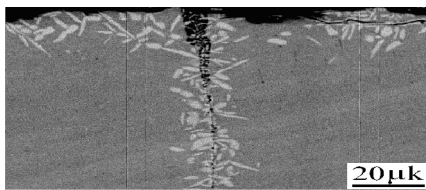


Fig. 2. SEM image of cross-section FeCoCrNiAl alloy after annealing at 1273 K/2h

At a temperature of 1073 K in addition matrix ordered BCC phase by HT X-ray was recorded reflections of the tetragonal σ -phase type CrFe in an amount of 64 wt. % (Fig. 1). After a slow cooling of the sample in the chamber to room temperature by using X-ray analysis revealed redistribution quantitative ratio in the phases (the number of σ -phase increased to 72 wt. %). To exclude the influence of the helium atmosphere in HT X-Ray camera on the formation of the phase composition of the surface layer additional annealing in a vacuum for 2h at 1073 and 1273 K were performed. Before annealing on surface alloy layer thickness $\sim 40 \mu\text{m}$ was removed. Annealing does not change phase composition, however, is fixed redistribution in the phase components and increases the period lattice of σ -phase.

Fig. 2 represented SEM image of cross-section FeCoCrNiAl alloy after annealing at 1273 K/2h. The thickness of the surface layer of σ -phase is about 20 – 22 μm . Precipitation of σ -phase is observed mainly on the sample surface and at least on the grain boundaries, as well as in grains body.

σ -phase has an elongated needle-like type.