

Microstructure of ball milled and compacted Co-Ni-Al alloys from β range

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Two compositions of powders corresponding to the β phase ($\text{Co}_{28,5}\text{Ni}_{36,5}\text{Al}_{35}$ and $\text{Co}_{35}\text{Ni}_{30}\text{Al}_{35}$) were ball milled in a high energy ball mill for 80 hours. The formation of amorphous structure was observed already after 40 hours of milling and further milling did not change the structure of powders. Analytical and high resolution TEM examinations of powders structure showed that besides of amorphous matrix the grains as small as 5 nm of L1_0 phase were observed. Chemical EDS point analysis of several milled powder particles revealed a high degree of chemical homogeneity of powders.

The hot pressing in vacuum of milled powders under the pressure of 400 MPa at 700°C for 12 min resulted in formation of compacts with density of about 70% of the theoretical one. The additional heat treatment at 1300°C for 6 hours followed water quenched, significant improved density and promoted martensitic transformation characterizing by a broad heat effect. The characteristic temperatures of this transformation were determined by DSC measurements and only small differences in their values depending on composition of alloys were observed. The TEM structure observations of heat treated alloys were performed on samples prepared by Focused Ion Beam (FIB) method. The structure was composed of grains of size of about 500 nm of ordered β (B2) phase. The SADP-s images taken at different orientations of B2 phase, revealed additional small spots from nanometer size precipitates in addition to the basic B2 spots. The crystal structure of the precipitates and the orientation relationship between B2 matrix and precipitates, were finally determined using high resolution electron microscopy. The chemical compositions of heat treated alloys were determined by EDS technique applying the High Angle Annular Dark Field (HAADF) detector.

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