[MS24-P09] High-entropy alloys.

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High-entropy alloys (HEAs) are the new class of alloys developed only about 10 years ago. HEA have been originally defined [1-3] as alloys composed of 5-11 principal elements with concentrations of 5-35 at. %. This definition opens a wide range of possibilities. We consider HEA as approximately equiatomic, single-phase, substitutional solid solution consisting of four or more metallic elements.

Until now, 24 HEA systems have been reported in the literature, which are based on different combinations of 4 - 9 elements out of 16. Two main research families can be identified: I - combinations of light transition metals with Al, and II - solid solutions of refractory metals, only. All HEAs known so far have simple average crystal structures of either the cF4-Cu (fcc), the cI2-W (bcc) or the cP2-CsCl type.

The most investigated systems are Cr-Fe-Co-Ni-Al-Cu and Cr-Fe-Co-Ni-Al. This element selection resembles that of Heusler phases (a typical representative is Cu2MnAl), which are ordered variants of the cI2-W-type (2X2X2 supercells). Locally, in bcc HEAs, related atomic arrangements may be found. HEAs are potentially very valuable materials, which can have a variety of different tunable properties, depending on the elements present within and their concentration (the so-called 'cocktail effect') [4]. Some HEAs are promising materials for industrial applications due to their superior mechanical properties, which can be comparable to superalloys, in particular at high temperatures. The high hardness and strength of the alloys is assumed to result mainly from random lattice distortions caused by the different atomic sizes, similar to what is known as solid solution strengthening for low concentrations of foreign atoms.

The ingots with the nominal compositions $CrFeCoNiAl_{2-x}$ (x = 0-1) were synthesized by arc melting. Samples were homogenized in tantalum or quartz ampoules at 1300, 1100, 900 and 700 ºC for 1, 2, 4 and 6 weeks, respectively. Differential thermal analysis, Xray powder and single-crystal diffraction and electron microscopy measurements were performed.

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[3] J.W. Yeh, S.K. Chen, S.J. Lin, J.Y. Gan, T.S. Chin, T.T. Shun, C.H. Tsau, S.Y. Chang, Adv. Eng. Mater. 6 (2004) 299-303.
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