Structure and magnetism of AlCoCrCuFeNi high-entropy alloy

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Multicomponent systems like AlCoCrCuFeNi are usually investigated due to their significant hardness caused by the high configurational and mixing entropies. The term High Entropy Alloys is used when at least five of the components have at least 5% molar fraction [1,2]. This work aims at investigation of magnetic and structural properties of AlCoCrCuFeNi, which is known to crystallize in a dual phase solid solution: the face-centred cubic (FCC) or the body-centred cubic (BCC). The results of neutron (NPD) and synchrotron powder diffraction (SXRD) allow to partially resolve magnetic information coming from BCC and FCC phases, which is impossible in the bulk magnetic measurements. Electron diffraction (PED) revealed that AlCoCrCuFeNi forms dendritic microstructure with the Cu-rich FCC phase and the Ni-rich BCC phase. Lattice parameters obtained from PED method are in good agreement with parameters obtained after refinement on the basis of powder X-ray diffraction measurements. The local crystal and electronic structure around Co was studied using Co-K X-ray Absorption Spectroscopy (XAS). The magnetic measurements show that AlCoCrCuFeNi reveal a ferromagnetic transition at about 330 K and displays magnetic hysteresis loop at the room temperature. Results from NPD suggest that the magnetic moment is mostly located in the BCC subsystem. The alloy shows soft magnetic properties. Saturated magnetizations (Ms), remanence ratio (Mr/Ms) and coercivity (Hc) of the cast are estimated to be 45.10 emu/g, 4.5% and 76 Oe, respectively. Finally, the BCC-FCC phase transformation up to 673 K was investigated using temperature dependent NPD, where a possible second BCC phase was identified.

References:

[1] J.W. Yeh et al. Advanced Engineering Materials 6(2004), 299.
[2] B. Cantor et al. Materials Science and Engineering: A. 375-377 (2004), 213.