Magnetic Properties of High Entropy CoCrFeMnNi Alloy Prepared by High Energy Ball Milling

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A novel approach to the fabrication of a new class of alloys - also known as high-entropy alloys (HEAs) was developed by Yeh et al. [1]. The HEAs containing at least 5 components in equiatomic or nearly equiatomic amounts (ranging between 5 and 35 at. %) are attractive in terms of mechanical, thermal, electrical and magnetic properties [2]. These HEAs are stabilized by the increased mixing entropy which suppresses the formation of binary and ternary metallic phases and thus favors the formation of solid solutions of many elements.
HEAs have been fabricated by several methods, including arc melting and casting, mechanical alloying, and laser cladding. Among these, especially promising seems to be high-energy ball milling (HEBM) in planetary ball mills that can yield stable microstructures and nanocrystalline alloys of better homogeneity compared to other non-equilibrium processes [3].
We report the fabrication of CoCrFeMnNi HEA 80-120 μm particles by high-energy ball milling (HEBM) and provide their structural and magnetic characterization. Our XRD, SEM, and EDX results showed that a fcc CoCrFeMnNi solid solution with uniform distribution of the elements and refined microstructure of nanosized grains (~10 nm) could be obtained after 60 min HEBM. Magnetic studies reveal very complex behavior: spin glass magnetic response below 50 K; intrinsic exchange bias and vertical shift of the hysteresis loop after field cooling. Isothermal aging after quench down to the low temperature shows a typical features of the out-of-equilibrium dynamics of spin glass with slow relaxation processes.
This presentation intents to instigate a discussion on X-Ray spectroscopy techniques capable to elucidate the intriguing magnetic phenomena of HEAs.

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