Structurally disordered $Ce(Fe_{0.9}Co_{0.1})_2$ metamagnet: electronic structure, magnetism and magnetocaloric effect

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Electronic structure, magnetic and magnetocaloric properties of $Ce(Fe_{0.9}Co_{0.1})_2$ alloy with the C15 cubic Laves phase are discussed. This well known metamagnet was synthesized by melt-spinning, which enabled formation of quenched-in structural disoder in the way reported by us for YCo_2 [1]. Subsequently, as-quenched ribbons were plastically deformed to cause further microstructural modifications and analyse their impact on magnetic and magnetocaloric properties. It is known that the crystal structure of the monocrystalline $Ce(Fe_{0.9}Co_{0.1})_2$ becomes distorted to rhombohedral symmetry at 90 K in zero magnetic field. While decreasing temperature, the process is accompanied with the magnetic phase transition from the ferromagnetic to the antiferromagnetic state. Due to structural disorder significant volume fraction of the deformed sample retains its ferromagnetism, while remained antiferromagnetic phase undergoes metamagnetic transition to the ferromagnetic state with applied magnetic field. Magnetic entropy change for the inverse magnetocaloric effect observed in the vicinity of antiferro-ferro transition is significantly reduced from about 1.45 J/kg K ($\Delta\mu_0 H = 2$ T) for melt-spun ribbon to about 0.15 J/kg K in plastically deformed sample. Moreover, in the framework of the Density Functional Theory we discuss the electronic structure of the alloy with antiferromagnetic and ferromagnetic ordering.

References:

[1] Z. Śniadecki et al., Phys. Rev. B 98 (2018) 094418.