Magnetism and magnetocaloric effect in structurally disordered $Ce(Fe_{0.9}Co_{0.1})_2$ metamagnet

W. Janiszewska,[1,2] M. Pugaczowa-Michalska,[1] M. Kołodziej,[1] N. Lindner,[1] Yu. Ivanisenko,[3] and Z. Śniadecki[1]

[1] *Institute of Molecular Physics, Polish Academy of Sciences, M. Smoluchowskiego 17, 60-179 Poznań, Poland*

[2] *Faculty of Materials Engineering and Technical Physics, Poznan University of Technology, Piotrowo 3, 60-965 Poznań, Poland*

[3] *Institute of Nanotechnology, Karlsruhe Institute of Technology, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany*

Electronic structure, as well as magnetic and magnetocaloric properties of $Ce(Fe_{0.9}Co_{0.1})_2$ alloy with C15 Laves phase are presented. Metamagnetic behavior, well-known for ordered form of this compound, was also observed for melt-spun sample, where quenched-in structural disorder was reported, as in the case of YCo_2 [1]. Following, as-quenched ribbons were plastically deformed to induce further microstructural modifications. Their impact on the magnetic and magnetocaloric properties was analyzed with the emphasis put on the metamagnetic transition and the presence of antiferromagnetic phase. Cubic $Ce(Fe_{0.9}Co_{0.1})_2$ is known to distort into rhombohedral symmetry at 90 K in zero magnetic field. As the temperature decreases, a magnetic phase transition from ferromagnetic to antiferromagnetic state occurs. However, a significant volume fraction of the deformed sample retains its ferromagnetic properties due to structural disorder. The remaining antiferromagnetic phase undergoes expected metamagnetic transition to ferromagnetic state with an applied magnetic field. The decrease in volume of the antiferromagnetic phase is also reflected in a significant reduction of magnetic entropy change for the inverse magnetocaloric effect in the vicinity of antiferro-ferro transition. The ΔS_m value decreased from 1.45 J/kg K ($\Delta\mu_0 H = 2T$) for melt-spun ribbon to about 0.15 J/kg K for plastically deformed sample. Moreover, we discuss the electronic structure of the alloy with antiferromagnetic and ferromagnetic ordering in the framework of the Density Functional Theory.

References:

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