Crystallographic, magnetic and magnetocaloric properties in Yb-based alloy

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In the last decades, intermetallic materials have attracted a lot of attention due to their intriguing properties. Systematic research of rare earth elements based on Eu, Ce and Yb, their combination and preparation of alloys and compounds offers very interesting physical results as high temperature superconductivity, quantum criticality or heavy-fermion behaviour, recently published e.g. [1, 2]. Particular classes are Yb-based alloys and compounds that show long-range magnetic order in the low temperatures range. More suitable objects for advanced materials are those which are ideal for magnetic refrigeration. Mentioned phenomenon based on the magnetocaloric effect is often more environmentally friendly and offers high energy efficiency than the refrigeration system's existing on the base of conventional gas compression e.g. [3]. Nowadays, it is essential to find other alternatives for refrigeration. To explore Yb-based magnetic material with extended the working temperature span with magnetic entropy changes, $Yb_{0.5}Gd_{0.5}Ni_5$ alloy has been prepared. The crystallographic structure, magnetic and magnetocaloric properties were studied. XRD patterns of the studied alloy shows two phases. The main phase belongs to $CaCu_5$ type crystal structure with *P6/mmm* space group as whole RNi_5 (R-rare earth) [3]. The presence of the second phase will be described in details. From the isothermal magnetization data, a magnetic entropy changes -ΔS_M was determined by a formula using the Maxwell's thermodynamic relations, and a broad maximum at $\sim$ 24 K is observed. The most remarkable fact is the asymmetric shape of maximum with a tail at higher temperatures. It can be explained due to the spin fluctuations effect [4]. It means that alloy and compounds with multiple magnetic transitions might create new materials to attain magnetic refrigeration technology in a broad temperature range compared to classical materials. Further study of $Yb_{0.5}Gd_{0.5}Ni_5$ alloy involving a full suite of physical properties, which are in progress, will be explained. The investigation of new intermetallic materials suitable for magnetic refrigerant opens the possibility of being more environmentally friendly, which recommends this alloy for possible future applications.

References:

[1] I. Curlik et al., Acta Physica Polonica A 122, 6-8 (2012)
[2] J. G. Sereni et al., Physical Review B 98, 094420 (2018)
[3] A. Dzubinska et al., Acta Physica Polonica A 131, 997-999 (2017)
[4] T. P. Rashid et al., Journal of Applied Physics 122, 093903 (2017)

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