Influence of thermal and magnetic couplings on magnetocaloric effect in multiphase stacked sample made of $LaFeMnSi_{13}$-H_x alloys

R. Gozdur,[1] T. Przerywacz,[1] K. Chwastek,[2] and P. Gębara[3]

[1] *Dept. of Semiconductor and Optoelectronic Devices, Lodz University of Technology,*
[2] *Faculty of Electrical Engineering,*
Czestochowa University of Technology
[3] *Institute of Physics, Czestochowa University of Technology*

The work concerns the study of the magnetocaloric effect for applications in magnetic cooling technology. One of the known problems of the technology is the narrow temperature range near Curie Temperature T_{Curie} [1], where entropy changes are sufficient to initiate heat transfer in the thermomagnetic cycle. The range can be increased by combining single magnetocaloric components with different T_{Curie} temperatures into multiphase structures [2]. However, the influence of inactive magnetocaloric components on the transient thermal response of the structure is adverse. Peak temperatures of operating components caused by entropy changes are dumped by inactive components due to their thermal coupling [3].

The presented findings show the magnetocaloric effect in the composite structure made of $LaFeMnSi_{13}$-H_x samples with magnetic phase transitions at 298K, 303K, 308K [4,5]. The composite structure was made of stacked rectangular plates 30x30x0.5mm and assembled with active thermal and magnetic spacers. The influence of thermal and magnetic couplings was investigated by the direct measurement of the magnetocaloric effect under magnetic field excitation (0.5-1.5T).

On the basis of experimental data a simplified model of thermal response of the multiphase magnetocaloric system was formulated and validated. The model allows one to estimate the thermal behavior of the magnetic regenerator containing a given number of field and temperature-dependent interacting magnetocaloric components. Details of experimental studies and the formulated model of the thermomagnetic couplings in magnetocaloric structures will be discussed in the presentation.

References:

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