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Giant magnetocaloric effect in alternating magnetic fields

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The solid state magnetic working body in the magnetic refrigerators is subjected to a strong alternating magnetic field. That is why the alternating magnetic field behavior is crucial for theproperties of the prospective magnetocaloric materials. First of all the giant magnetocaloric effect (GMCE) should express itself in alternating magnetic field. GMCE is mainly observed in the substances where both magnetic and structural phase transitions (PTs) are present and merged in one magnetostructural PT. In these materials the total change of entropy at external magnetic field change may consists of two impacts: magnetic and lattice ones. They can be expected to depend strongly on the frequency of the magnetic field applied. The present work is devoted to the study of the GMCE and magnetostriction in the alloys Fe48Rh52, Ni-Mn-In and manganite Sm1-xSrxMnO3 in alternating magnetic field by the technique described elsewhere

[1]. The magnetic-field-induced magnetostructural PTs in these materials (antiferroferromagnetic in the cases of Fe48Rh52 and Heusler alloy Ni-Mn-In, and para- ferromagnetic in case of Sm1-xSrxMnO3) are accompanied by the strong lattice volume changes which also gives an impact to entropy.
We report that the correlation is observed of magnetostriction and GMCE in these materials.
Both MCE and magnetostriction are negligible in small alternating magnetic fields. Starting from some threshold magnetic field both MCE and magnetostriction express themself. We come to the following conclusions: GMCE is strongly expressed in the alloys where antiferroferromagnetic PT is accompanied by lattice contraction (FeRh, and Ni-Mn-In) only in the fields stronger than that of needed for the shift the temperature of PT TN+(H) below the temperature of reverse transition in zero field TN-(0) (at TN+(H) < T < TN-(0)). In substances,

like manganite Sm1-xSrxMnO3, in which ferro- paramagnetic PT is accompanied by the lattice expansion, the GMCE expresses at temperatures higher than TC+ in the regime of zero-field heating and below TC+(H) at TC+ < T < TC+(H)).

References:

[1] Aliev, A. M., Batdalov, A. B., Kamilov, I. K., et al. Appl. Phis. Lett. V. 97, 212505 (2010)