# ADVANCED MAGNETOCALORIC MATERIALS

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## ABSTRACT

The discovery of the giant magnetocaloric effect in $Gd_5Si_2Ge_2$ and other $R_5T_4$ compounds (R = rare earth metal and T is a Group 14 element) generated a broad interest in the magnetocaloric effect and magnetic refrigeration near room temperature in particular, and in magnetostructural transitions in general. Reports on the giant magnetocaloric effect in other systems soon followed. These include $MnFeP_xAs_{1-x}$ and related compounds, $La(Fe_{1-x}Si_x)_{13}$ and their hydrides, $Mn(As_xSb_{1-x})$, $CoMnSi_xGe_{1-x}$ and related compounds, $Ni_2MnGa$ and some closely related Heusler phases, and a few non-metallic systems. A common feature observed in all giant magnetocaloric effect materials is the enhancement of the magnetic entropy effect by the overlapping contribution from the lattice, regardless whether it is a massive structural change like in $R_5T_4$ compounds or $MnFeP_xAs_{1-x}$–type compounds, or only a phase volume change as in $La(Fe_{1-x}Si_x)_{13}$. In addition to the interplay between magnetic and lattice entropies, both of which are intrinsic materials' parameters that in principle can be modeled theoretically from first principles, extrinsic parameters such as microstructure and nanostructure, have been found recently to play a role in controlling magnetostructural transition(s) and magnetocaloric effect. Both the intrinsic and extrinsic parameters are, therefore, important in order to have the optimum magnetocaloric effect. The role of different control parameters and the potential pathways towards materials exhibiting advanced magnetocaloric effect will be discussed.

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