

Design of Advanced Materials for Alternative Cooling Devices

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Abstract : More efficient cooling systems are needed to reduce building energy consumption and environmental impact. At present researchers focus mainly on environmentally-friendly magnetic materials and the potential application in cooling devices. The magnetic materials presented in this project belong to a group known as Heusler alloys. These compounds are characterized by a strong coupling between their structure and magnetic properties. Usually, a change in one of them can alter the other, which implies changes in other electronic or structural properties, such as, shape magnetic memory response or the magnetocaloric effect. Those properties and its dependence with external fields make these materials interesting, both from a fundamental point of view, as well as on their different possible applications. In this work, first principles and Monte Carlo simulations have been used to calculate exchange couplings and magnetic properties as a function of an applied magnetic field on Heusler alloys. As a result, we found a large dependence of the magnetic susceptibility, entropy and heat capacity, indicating that the magnetic field can be used in experiments to trigger particular magnetic properties in materials, which are necessary to develop solid-state refrigeration devices.

Keywords : ferromagnetic materials, magnetocaloric effect, materials design, solid state refrigeration

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