THERMAL RECTIFICATION VIA FERROMAGNETIC MATERIALS

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In an ideal model, a thermal rectifier is the thermal equivalent of the electrical diode, a device which leads a greater heat flow in one direction than another one. It is well known that heat transfer in solids basically depends on the electrical, magnetic and crystalline nature of materials via electrons, magnons and phonons as thermal energy carriers respectively. In the present research, it is presented the potential of ferromagnetic materials in the development of solid state thermal rectifiers. Experimentally, it is shown that thermal diodes based on NiCu alloys can control the heat flux via the second order phase transition through the Curie temperature. This striking characteristic enables the development of thermal rectifiers with a well-defined breakdown as well as forward temperatures which control accurately the on/off state of the device, similarly to the forward and breakdown voltages of the electrical diode. Furthermore, diode performance can be further enhanced by thermal resistance matching between slabs as well as by improving the magnetic properties of the alloy. This approach shed a light to pursuit high performance thermal diodes at room temperature in a simple way and opens a new route towards the next generation of thermal devices.

Keywords: Thermal rectification, Ferromagnetic-Paramagnetic Transition, Curie Temperature

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