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Synthesis and Characterization of Ferromagnetic Ni-Cu Alloys for Thermal Rectification Applications

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Abstract : A thermal rectifier consists of a device which can load a different heat flow which depends on the direction of that flow. That device is a thermal diode. 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, we have synthesized polycrystalline Ni-Cu alloys and identified the Curie temperatures; and we have observed that by way of secondary phase transitions, it is possible manipulate the heat conduction in solid state thermal diodes via transition temperature. In this sense, we have succeeded in developing solid state thermal diodes with a control gate through the Curie temperature via the activation and deactivation of magnons in Ni-Cu ferromagnetic alloys at room temperature. Results show thermal diodes with thermal rectification factors up to 1.5. Besides, the performance of the electrical rectifiers can be controlled by way of alloy Cu content; hence, lower Cu content alloys present enhanced thermal rectifications factors than higher ones.

Keywords : thermal rectification, Curie temperature, ferromagnetic alloys, magnons
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