INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

A simple template-less chemical route was developed to synthesize ternary Heusler alloy nanoparticles. *viz.*, Co_2FeGa, Fe_2CoGa, and Fe_2CoAl. After establishing a procedure to obtain phase pure and highly ordered near-stoichiometric Heusler alloy compounds in nanoparticle form, the variation of magnetic properties of these nanoparticles as a function of crystallite size was explored. Having mastered the procedure to obtain the nominal stoichiometry in the Heusler alloy compounds, $Fe_{2-x}Co_{1+x}Ga$ ($0 \leq x \leq 1$) nanoparticles were synthesized, and their composition dependent properties were determined. Finally, the synthesis of a quaternary Heusler alloy nanoparticle was demonstrated for the first time by preparing $Fe_2CoGa_{0.5}Al_{0.5}$ nanoparticles. This showcased the prowess of the developed methodology to synthesize other intermediate off-stoichiometric quaternary Heusler alloy compositions. The experimental research carried out has been supported by theoretical studies. These include the prediction of magnetic properties, electronic density of states, and half metallic properties of these Heusler alloys and interpretation and validation of the experimental results with standard theoretical models. The results not only showcase the spirit of the methodology to obtain such a highly ordered, impurity free, single phase, single domain, soft ferromagnetic Heusler alloy nanoparticles with enhanced structural and magnetic properties but also bring out insights and information about these nanoparticle alloys not known so far. These studies also help us in understanding the behavior of these systems so that they can be effectively utilized in practical applications because of their enhanced magnetization, Curie temperature, and magnetic anisotropy coupled with low coercivity.
