Structural and magnetic characterization of magnetic multi-layered Fe-Ga thin films for applications in magnetic sensor devices

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Fe-Ga alloys (Galfenol) have recently received intense interest due to their giant magnetostriction in low saturation magnetic fields, with possible applications in many industries, including automotive, biomedical [1], defence and aerospace. Magnetostrictive materials can be used as actuators, strain sensors, magnetometers [2], generators of ultrasonic waves or high precision positioning devices. In addition, the emergence of compact cavity-based strain sensors has seen a renewal of interest in magnetostrictive thin films [2,3]. While the influence of the composition of Fe-Ga on its magnetostriction is well-studied for the bulk material [4], for thin films, the final crystallographic structures and the potential additional induced stresses are still new topics of research [5] with many points still to be understood.

Our objective is to study the effects of single and multi-layers' thicknesses on the structural and magnetic properties of Fe-Ga thin films deposited by magnetron sputtering on flat silicon (100) wafer substrates.

Structural characterization by Scanning Electron Microscope, Energy Dispersive x-ray Spectroscopy, Electron Backscattering Diffraction, and X-ray diffraction reveals that Fe-Ga thin films have a columnar structure. Investigations of the magnetic properties used a Vibrating Sample Magnetometer to obtain magnetic hysteresis loops to analyse magnetic anisotropy.

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