Characterization of MnAl and MnBi films using XPS

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X-Ray Photoelectron Spectroscopy (XPS) is used for surface analysis of materials, in particular composition and distribution of chemicals in layered materials. We will apply this technique to the study of thin film permanent magnet materials for process refinement and control. MnAl has great potential for permanent magnet applications because of its high energy product $(BH)_{max}$ and high coercivity [1]. MnBi also has desirable magnetic properties for this application. The ferromagnetic phases of thin films MnAl and MnBi have magnetic properties that are sensitive functions of Mn concentration [2], so it is necessary to collect information about the composition of these materials.

In XPS, an intensity vs. energy spectrum consisting of peaks at specific binding energies is collected [3]. The peak intensities tell us how much of a material present on the surface while the position of the peak gives information about the elemental and chemical composition of the material. The binding energies of the peaks in the XPS spectrum are used to identify the elements present in the sample. The elemental composition can then be used to identify thermodynamically stable crystallographic phases [4].

MnAl and MnBi films, prepared by magnetron sputtering will be studied as a function of layer thickness, annealing temperature and other process conditions. The goal of the studies is to adjust the process conditions to obtain desired magnetic phases of the Mn alloy films. In addition, layered films consisting of Mn alloys laminated with high moment materials will be studied to plot a route toward producing rare-Earth-free permanent magnet materials.

References

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