MAGNETIC PROPERTIES OF Co-Tb ALLOY FILMS WITH CONTROLLED CONCENTRATION AND THICKNESS GRADIENTS

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Studies aimed at developing new thin film materials and optimizing their compositions and thicknesses for application in fields such as e.g. electronics, information technologies, photonics, photovoltaics, spintronics, and magnonics have been carried out in numerous laboratories worldwide for several decades now. Among the various methods of producing complex thin film systems in ultra-high vacuum condition, both in industrial and laboratory settings, magnetron sputtering is among the most frequently used. Based on this method, we have developed a technology for fabrication of alloy layers with well-defined, mutually perpendicular gradients of composition and thickness [1].

This technology will be discussed on the example of ferrimagnetic/sperimagnetic rare earth-transition metal films with perpendicular magnetic anisotropy, because these systems have experienced a renaissance in recent years thanks to newly discovered magnetic properties such as: all-optical switching [2], fast domain wall propagation [3], creation and propagation of skyrmions [4] and existing magnetic domains without domain walls [5,6].

Proposed technology based on co-sputtering from two magnetron sources and allows to obtain monotonic (approximately linear) changes in concentration along a specific direction of the substrate, and the gradient of this concentration can be controlled by changing the distance between the targets and the substrate. Using this method and linearly moved shutter the sperimagnetic Co-Tb alloy films with mutually orthogonal concentration and thickness gradients were fabricated. On the basis of magnetooptical measurements it was demonstrated that for thicknesses below 10 nm, the compensation concentration (c_{comp}) shifts towards higher Tb concentration as the thickness of Co-Tb film is reduced. Results of Co-Tb alloy films are compared with $(Tb/Co)_{RN}$ multilayers characterized by different repetition number (RN). For both sample types the c_{comp} decrease in a similar way with increasing total film thickness.

Thus decrease of c_{comp} with the total thickness of alloy films or multilayers can be seen as an universal behavior.

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