Structure and Properties of magnetron-sputtered Manganese Ferrite Films

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Abstract

In the present work, manganese ferrite films with the addition of chromium have been produced by reactive pulsed magnetron sputtering of alloyed targets. Layers with thicknesses between 0.5 and 2 µm have been deposited onto flat samples of stainless steel and borosilicate glass. The substrate temperature was in the range from 150°C to 600°C, and the oxygen content in the gas atmosphere was set to different values stabilized by a feedback control. Whereas at lower substrate temperatures smooth nanocrystalline films with distinct residual reflectance are formed, at temperatures of 600°C films with widely varying optical properties and structures arise. Layers with lower oxygen content show a deep black appearance with no transmittance and only minor reflectance. At higher oxygen contents, the transmittance in the red and infrared region strongly increases. In the region of lower oxygen contents, cermet structures with metallic precipitations in a nanocrystalline matrix are formed. At high oxygen content single-phase crystalline layers of spinel type consisting of elongated wedge-shaped crystallites arise. From X-ray diffraction measurement, it was concluded that the metallic precipitations can be assigned to an intermetallic Fe-Cr phase, and the crystalline matrix was of $MnFe_2O_4$ spinel type.