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Microstructure and magnetic properties dependence on the thickness of $Tb_xDy_{1-x}Fe_2$ thin films sputtered on $Pt/TiO_2/SiO_2/Si$ substrate

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ABSTRACT

$Tb_xDy_{1-x}Fe_2$ (Terfenol-D) thin films were grown in situ at 500°C on $Pt/TiO_2/SiO_2/Si$ substrate by multi-target sputtering. The thickness effect of the Terfenol-D layer on the microstructure and on the magnetic properties was investigated. Magnetic Force Microscopy was used to observe local domain patterns. Strong changes in the shape of magnetic domains were observed when the thickness of the Terfenol-D film was increased. Transmission Electron Microscopy observations showed that in situ elaboration at 500°C gives rise to large diffusion of the platinum of the bottom electrode into the Terfenol-D film leading to different sub-layers. Saturation magnetization values increased from 500 to 840 kA/m, and coercive fields from 15 to 140 kA/m, respectively, when the thickness of the Terfenol-D film was varied from 100 to 1000 nm. Co-sputtering of Pt and Terfenol-D through the entire film thickness led to a similar saturation magnetization as well as an interesting strong decrease of the coercive field of these mixed films.

Keywords: Ferromagnetism, TERFENOL-D, microstructure, TEM-STEM-HAADF, Magnetic Force Microscopy, thin film.