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Interface structure of CoFeB/MgO magnetic tunnel junctions from hard x-ray photoelectron spectroscopy S. MUKHERJEE, D.D. SARMA, B. PAL, Solid State and Structural Chemistry Unit, IISc, Bangalore, India, R. KNUT, J. ÅKERMAN, Department of Physics, University of Gothenburg, Sweden, S. THIESS, W. DRUBE, DESY, Hamburg, Germany, M. GORGOI, Helmholtz Zentrum Berlin, Berlin, German, A. SAHOO, P. ANILKUMAR, Department of Physics, IISc, Bangalore, India, J. PERSSONS, Royal Institute of Technology, Stockholm, Sweden, O. KARIS, Department of Physics and Astronomy, Uppsala University, Sweden — Present sensors in hard drives rely on tunnel magnetoresistance (TMR) in CoFeB/MgO/CoFeB structures. The device fabrication has been refined to meet strict demands. Despite this, fundamental understanding of the optimization process, i.e. post-annealing, is missing. In particular, boron diffusion has been suggested to be integral to the creation of a textured CoFe alloy with boron diffused either into the MgO tunnel barrier, forming boron oxides, or into a seed layer. Such diffusion would thus indirectly be essential for a large MR in the device. We have used hard x-ray photoelectron spectroscopy (HAXPES), to investigate a series of CoFeB/MgO/CoFeB structures. By systematically studying the modifications of chemical state of various constituents for different structures and post-annealing conditions, we are able to provide a detailed geometric interpretation of how elements diffuse and modify the structure. In particular we show that at the annealing temperatures required for achieving optimal MR, boron diffusion is limited to a very thin (sub-nm) region at the interface and does not progress beyond this point.

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