The growth and the X-ray diffraction profiles of the spin valve magnetic tunnel junctions

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Spin valve magnetic tunnel junctions (SV-MTJs) with the structure: Si(100)/ SiOx/***buffer***/IrMn/CoFe/AlOx/NiFe/Ta were deposited on different ***buffers***: ***a***: Cu, ***b***: Ta/Cu, ***c***: Ta/Cu/Ta/Cu and ***d***: Ta/Cu/Ta/NiFe/Cu. These multilayer systems were investigated by X-ray diffraction using θ-2θ scans, rocking curve and pole figure measurements. Using Scherrer's formula grains sizes were determined and the interface roughness from reflectivity curves were obtained. Different systems of buffer layers strongly influence the texture of the layers. The ***a*** junctions were characterized by the lowest degree of texture and the smallest amplitude of roughness and ***b*** junctions by the highest degree of texture and the highest amplitude of roughness. Junctions ***c*** and ***d*** were characterized by a medium texture and roughness. The correlations between microstructure parameters (texture, grain size, roughness) and magnetic exchange coupling parameters (Nèel coupling, exchange bias) of investigated multilayer systems were found.

For all types of junctions simulations of θ-2θ profiles were carried out. In the first step the structure of grains in perpendicular direction has been simulated (Fig. 1) using Monte Carlo method. In the second step, by kinematical theory of scattering, the θ-2θ profile has been calculated (Fig. 2) using as parameters: grain sizes, roughness amplitudes and interplanar distances determined by XRD. Very well agreement between calculated and measured profiles indicates textured growth in the columnar like fashion as was modelled.

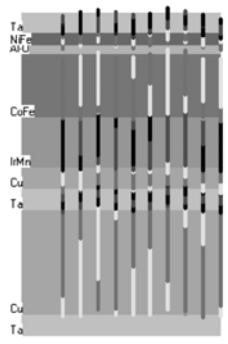

Fig. 1. Simulation of grains structure of sample with ***c*** buffer.

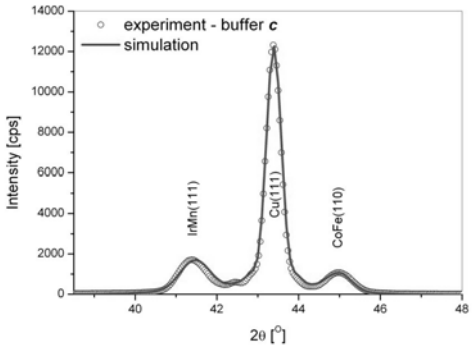

Fig. 2. Measured (circles) and simulated (solid line) θ-2θ profiles for sample with ***c*** buffer.

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