MS15-1-5 Structure, texture and residual strain in Al/W/Al heterostructures
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Abstract
Thick metallic films are widely used in microelectronics, as for example for interconnection purposes and metallic contacts. The structural properties of these films have a certain influence on their performances, but even more, residual strains are to be evaluated and controlled, as they can lead to local distortions and deformations of the die, and in the worst case to reliability issues.
This contribution reports on the structural and textural characterization of a heterostructure of Aluminium-Tungsten-Aluminium (AWA) by means of X-ray diffraction. The layered stack is obtained by sputtering, on a Si-(001) substrate covered by a 30 nm thermal SiOx layer. The bottom Al layer has a thickness of 3 µm, and the top Al-layer a thickness of 10 µm. The two Al layers are separated by a W layer of 300 nm. The structure, texture and microstructure of the three layers composing the heterostructure have been investigated by interpreting the diffraction diagrams using the so-called “Combined Analysis” formalism [1] implemented in the MAUD software [2]. This method is based on cyclic Rietveld refinements [3] of the diffraction patterns measured for 864 different sample orientations. In this study, the texture is quantified through the refinement of the Orientation Distribution Function (ODF) of crystallites using the E-WIMV method [1], the anisotropic crystallite sizes and microstrains using the Popa anisotropic formalism [4] and the residual stress biaxial tensor using tensor homogeneization by geometric mean of single-crystal elastic constants weighted by the ODF [5]. We carried out the measurements with a ThermoFisher Scientific 4-circles X-ray diffractometer, Cu Kα radiation (λCu= 1.5418nm), equipped with a curved position sensitive detector (INEL CPS 120).
Strong fibre-like textures are evidenced in all Al and W layers, the fibre axes corresponding to the main crystal directions ([111] and [001] resp.), being perpendicular to the sample plane with a maximum orientation density on the corresponding pole figures of 30 m.r.d. and 6 m.r.d.. While the tungsten layer exhibits relatively large residual stresses s11 = 3.36 GPa and s22 = 3.32 GPa, the aluminium appears free of residual stress.
An overview of the main results will be given in this contribution.

References
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XRD measured data and fit.