Interface stress in Au/Ni multilayers

The effect of intermixing on the apparent interface stress is studied in <111>-textured dc-magnetron sputtered Au/Ni multilayers by use of two methods commonly used for determining interface stress. The method using profilometry and in-plane x-ray diffraction does not take intermixing into account and yields an apparent interface stress of -8.46 +/- 0.99 J m(-2). However, observed discrepancies between model calculations and measured high-angle x-ray diffractograms indicate intermixing, and by use of the profilometry and sin(2) psi method the real interface stress value of -2.69 +/- 0.43 J m(-2) is found. This method also reveals a significant and systematic change of the stress-free lattice parameter of both constituents as a function of modulation period which is shown to account for the difference between the two findings. The method using in-plane diffraction is thus shown to be inapplicable to interface stress determinations in systems exhibiting a modulation period-dependent stress-free lattice parameter. Finally, a deviation of the interface stress in the Au/Ni sample with the smallest modulation period as compared to specimens with larger bilayer lengths is observed to be concurrent with a significant decrease in the interface roughness measured by x-ray reflectivity, which suggests that the deviation is of geometrical origin. (C) 2000 American Institute of Physics. [S0021-8979(00)08615-1].

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