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Report:

The experiments at ROBL led to an article submitted to J. Appl. Phys. under the title

Tensile and compressive interface stress in Cu/Ni and Au/Ni multilayers

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In this paper, we present studies of the interface stress in a multilayer with coherent interfaces, Cu/Ni, and in Au/Ni multilayers with incoherent interfaces. The <111>-textured multilayers were deposited by use of DC-magnetron sputtering and bulk and interface stresses were obtained from X-ray diffraction and measurements of substrate curvatures. The interface stress in Cu/Ni multilayers was found to be 0.77±0.19 J/m^2, i.e. a *tensile* interface stress in a metallic multilayer. The coherent/incoherent transition in Cu/Ni multilayers is observed at a critical bilayer repeat length of about 10.5 nm, in agreement with theory.

The interface stress in Au/Ni multilayers is found to be compressive, in agreement with theory, but the value of –8.46±0.99 J/m^2 is much larger than both the prediction by theory and more than twice as large as values reported for other systems. For the sample having the smallest repeat length, interface roughness and lattice parameters show, that this sample has weakly cumulative interfaces and a strong coherency effect, in contrast to samples with larger repeat lengths. This may explain the observed deviation of the interface stress.

In both systems, the high level of strain makes it necessary to include third-order stiffness coefficients in calculating the stress in the strong <111>-textured Cu/Ni and Au/Ni-multilayers.

The following figure shows as an example GIXRD diffractograms (gracing incidence X-ray diffraction) at the six-circle diffractometer of ROBL for Cu/Ni multilayers of four different bilayer repeat lengths. (The filled spheres, filled triangles, opened spheres and opened triangles represent bilayer repeat lengths of 5.6 nm, 10.5 nm, 14.8 nm and 23.1 nm, resp. The lines are fittings by use of Voigt peaks.)