Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Spatially-resolved Thin-film Alloy Compositions J.B. HANNON, IBM Research Division, J. SUN, Univ. of New Hampshire, K. POHL, Univ. of New Hampshire, G.L. KELLOGG, Sandia Nat.Labs — Controlling the composition of thin-film alloys is critical in a wide range of technologies. However, measuring alloy compositions at surfaces is difficult. Quantitative information on surface alloy compositions can be obtained from analysis of low energy electron diffraction (LEED) I-V curves, but, in nearly all LEED studies it is implicitly assumed that the structure and composition are spatially uniform. In this talk we describe low-energy electron microscopy (LEEM) experiments showing that surface steps can make alloy compositions inherently inhomogeneous. Specifically, we have investigated the formation of the well-known PdCu surface alloy phase on Cu(001). We show that surface steps introduce strong variation the electron reflectivity (i.e. in the LEED-IV curves) due to inhomogeneous Pd alloying. By analyzing the reflectivity using multiple-scattering LEED calculations we have determined the random surface alloy composition by using the average t-matrix approximation, with a spatial resolution of about 10 nm. We find that regions of the surface overgrown via step flow have excess Pd in the third layer, while regions far from steps have virtually no Pd in the third layer. We conclude that step flow buries Pd, which then becomes immobile. Surprisingly, post-growth annealing above 300 C is required to form a laterally homogeneous alloy film.

James Hannon
IBM Research Division

Date submitted: 01 Dec 2004 Electronic form version 1.4