

[총회초청 I]

Epitaxial Overlayers vs Alloy Formation at Aluminum-Transition Metal Interfaces*

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The synthesis of layered structures on the nanometer scale has become essential for continued improvements in the operation of various electronic and magnetic devices. Abrupt metal-metal interfaces are desired for applications ranging from metallization in semiconductor devices to fabrication of magnetoresistive tunnel junctions for read heads on magnetic disk drives. In particular, characterizing the interface structure between various transition metals (TM) and aluminum is desirable. We have used the techniques of MeV ion backscattering and channeling (HEIS), x-ray photoemission (XPS), x-ray photoelectron diffraction (XPD), low-energy ion scattering (LEIS), and low-energy electron diffraction (LEED), together with computer simulations using embedded atom potentials, to study solid-solid interface structure for thin films of Ni, Fe, Co, Pd, Ti, and Ag on Al(001), Al(110) and Al(111) surfaces. Considerations of lattice matching, surface energies, or compound formation energies alone do not adequately predict our results. We find that those metals with metallic radii smaller than Al (e.g. Ni, Fe, Co, Pd) tend to form alloys at the TM-Al interface, while those atoms with larger atomic radii (e.g. Ti, Ag) form epitaxial overlayers. Thus we are led to consider models in which the strain energy associated with alloy formation becomes a kinetic barrier to alloying. Furthermore, we observe the formation of metastable fcc Ti up to a critical thickness of 5 monolayers on Al(001) and Al(110). For Ag films we observe arbitrarily thick epitaxial growth exceeding 30 monolayers with some Al alloying at the interface, possible driven by interface strain relief. Typical examples of these interface structures will be discussed.

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