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Initial Metallization and Transition Metal Diffusion in ZnO Single Crystals, CVD-Grown Films, and Nanostructures SENIA KATALINIC, SYLVIE RANGAN, RODNEY GATEAU, PAN WU, YICHENG LU, ROBERT BARTYNSKI, Rutgers University — Transition metal doped ZnO is a promising candidate room temperature dilute magnetic semiconductor for spintronic applications. In previous studies indicate Fe or Mn dopants exhibit significantly different diffusion properties in ZnO. To explore whether this is an inherent property of ZnO or if it is related to non-ideal aspects of the films or nanostructures, we have studied the initial stages of Mn, Fe, and Cu metallization of the single crystal ZnO(0001)[Zn-terminated] and (11-20) surfaces, as well as MOCVD-grown epitaxial a-plane films using scanning tunneling microscopy and spectroscopy (STM and STS). While deposited Cu forms well defined islands, all three surfaces exhibit substantial disruption upon Fe deposition, including significant change in terrace widths and a markedly smaller fraction of atomic height steps. Upon annealing, Cu islands become mobile and coarsen, but the underlying ZnO structure is not strongly affected. Annealing with Fe on the surface, significant coarsening and roughening of the substrate occurs even at the modest annealing temperature of 200C, and this effect is enhanced upon annealing to 400 C. Initial results suggest that uptake of metals into the epi-film is predominantly determined by the properties of the (11-20) surface that terminates the film.

Robert Bartynski
Rutgers University

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