Superconformal Electrodeposition

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Electrodeposition of copper has been implemented in the fabrication of the latest generation of integrated circuits resulting in faster clock speeds, enhanced reliability and lower processing cost. Central to the success of the process is the ability to yield void and seam-free, bottom-up filling of high aspect ratio trenches and vias. Early models of “superfilling” assumed location-dependent growth rates derived from diffusion-limited accumulation of an inhibiting species. Such models were unable to predict several key experimental observations. Recently, a curvature enhanced accelerator coverage (CEAC) mechanism has been used to quantitatively predict superconformal electrodeposition of copper and silver in trenches and vias. The model also provides a simple explanation for the long-standing observation of the smoothing action provided by certain electrolyte additives (traditionally referred to as “brighteners“). This talk will focus on describing various electrochemical and surface analytical methods that are used to quantify the effect of additives on metal deposition kinetics of different Group 1B metals and direct application of this knowledge to superfilling sub-micrometer features.