Selective depositions enabled by surface functionalization and ALD

Silvia Armini

imec, Kapeldreef 75, 30001 Heverlee, Belgium
e-mail:armini@imec.be, web site: http://www.imec.be

Self-assembled molecular nanolayers composed of sub-1 nm organic chains and terminated with desired functional groups are attractive for modifying surface properties for a variety of applications, such as lubricants/anti-stiction for NEMS, in nanolithography, corrosion protection and surface functionalization. Monolayers can help engineering thin-film interfaces, both as active components in molecular devices, and as passive layers, inhibiting interfacial diffusion, promoting adhesion and toughening brittle nanoporous structures.

In this talk I will be giving a general overview of applications of SAMs in nanoelectronics. A special attention will be paid on: 1) nanointerconnect capacitance scaling by introducing porous low-k dielectrics and SAM pore sealing against indiffusion of the CVD Mn-based barrier precursors; 2) nanointerconnect metallization by enabling bottom-up electroless filling of sub-20 nm lines by a combination of SAM functionalization of the dielectric surfaces followed by metal catalyst immobilization on the terminal groups of the organic molecules.

Finally, I will be focusing a recent application of SAMs to enable Area-Selective Atomic Layer Deposition (AS-ALD) growth on functionalized surfaces having modulated surface energies. ALD is a thin film deposition method based on self-limiting reactions between gas phase precursors and specific functional groups at the substrate surface. This chemical specificity provides a means to achieve selectivity in ALD on a spatially patterned substrate. Selective growth is obtained by passivation of the surface using SAMs in the regions where deposition is not desired.
AS-ALD offer a number of advantages in transistor fabrication, including reduction of the lithography steps required and relaxation of the strict requirement for overlay and edge placement error in a multi-level interconnect scheme, elimination of complicated etching processes, and minimization of expensive and poisonous reagent use.