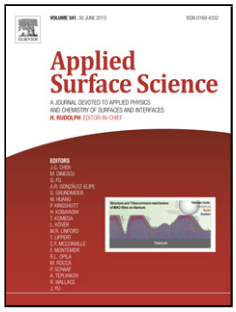

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On the use of (3-trimethoxysilylpropyl)diethylenetriamine self-assembled monolayers as seed layers for the growth of Mn based copper diffusion barrier layers

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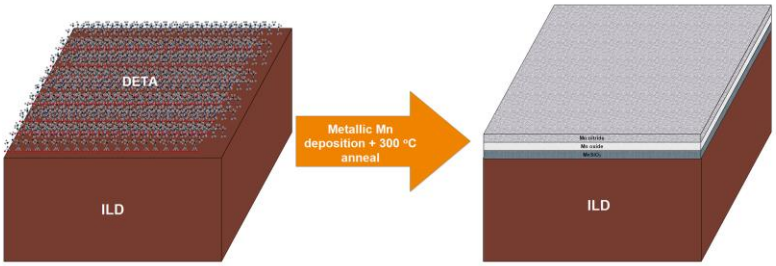
Graphical abstract



Highlights

In this work we show for the first time:

- DETA self-assembled monolayer stability in UHV conditions.
- Migration of thermally deposited manganese through the self-assembled monolayer to the ILD interface and subsequent $MnSiO_3$ formation.
- Mn metal interacts with the carbon and nitrogen in the DETA self-assembled monolayer by forming Mn-carbide and Mn-nitride, respectively.

Abstract

In this work x-ray photoelectron spectroscopy is used to investigate in-vacuo, the interaction of metallic manganese with a (3-trimethoxysilylpropyl)diethylenetriamine (DETA) self-assembled monolayer (SAM) on SiO_2 and non-porous low-k dielectric materials. Subsequent deposition of a ~0.5 nm thick Mn, followed by a 200^{o}C anneal results in the Mn diffusing through the SAM to interact with the underlying SiO_2 layer to form a Mn-silicate layer. Furthermore, there is evidence that the Mn interacts with the carbon and nitrogen within the SAM to form Mn-carbide and Mn-nitride, respectively. When deposited on low-k materials the Mn is found to diffuse through to the SAM on deposition and interact both with the SAM and the underlying substrate in a similar fashion.

Keywords: Self-assembled monolayers, manganese silicate, XPS, low-k dielectric, interconnects