Cu/SiO_2 films for 3D filling in microelectronic applications by an organometallic chemical liquid deposition (OMCLD) route

Kilian Piettre[a,b], *Virginie Latour*[a], *Olivier Margeat*[c], *Clément Barrière*[a], *Marina Proust*[b], *Benoît Riou*[b], *Bruno Chaudret*[a], *Pierre Fau*[a]*

[a] Laboratoire de Chimie de Coordination, 205, route de Narbonne, 31077 Toulouse,
[b] STMicroelectronics, 16, rue Pierre et Marie Curie, 37071 Tours
[c] Université de la Méditerranée, Faculté des Sciences, 163 av Luminy, 13288 Marseille
Kilian.Piettre@lcc-toulouse.fr

Organometallic chemistry has recently been emphasized [1] in microelectronics processes and new cost effective copper deposition films have been proposed [2, 3]. In this talk, we present a fully liquid method to specifically produce thin conductive copper films on silicon substrates at specific temperature and under specific H_2 pressure. Metallization of the surface will be achieved by simultaneous decomposition under reducing H_2 gas of a copper precursor ((N-N'-diisopropylactemidinato) copper (I)) in the presence of a silica source (tetraethoxysilane TEOS). This unique organometallic approach allows the formation of adherent copper/SiO_2 clusters around 100 nm thick, on silicon surfaces presenting a large aspect ratio. The continuous precursor availability in the liquid phase during deposition will allow good coverage of both walls and bottom structures and evenly deposit (figure 1)+.
The copper precursor decomposition is followed by nuclear magnetic resonance (NMR) monitoring and TEOS hydrolysis and condensation reactions are controlled by the precursor chemistry. The reaction pathways involved in the formation of these composite films are detailed and the process parameters are discussed. The resulting films are characterized by scanning electron microscopy (SEM), focused ion beam (FIB), back-scattered electrons (BSE) and X-rays diffraction (XRD). The resulting Cu/SiO_2 films present the double interest of forming an adherent copper layer directly on silica surfaces thanks to SiO_2 anchoring, and behave as an effective catalyst layer for a further deposition of thick copper by electroless technique. This approach can easily be extended to other classes of organometallic precursors and brings a new example of the growing role of organometallic chemistry solutions in the field of the actual microelectronic challenges.

[1] G. A. Somorjai, F. Tao and J. Y. Park, *Top. Catal.*, **2008**, 47, 1
[2] C. Barrière, P. Fau et al. J. Mater. Chem., **2008**, 18, 3084–3086
[3] O. Margeat, C. Barrière, P. Fau, B. Chaudret, **2009**, FR2929449_WO200912514

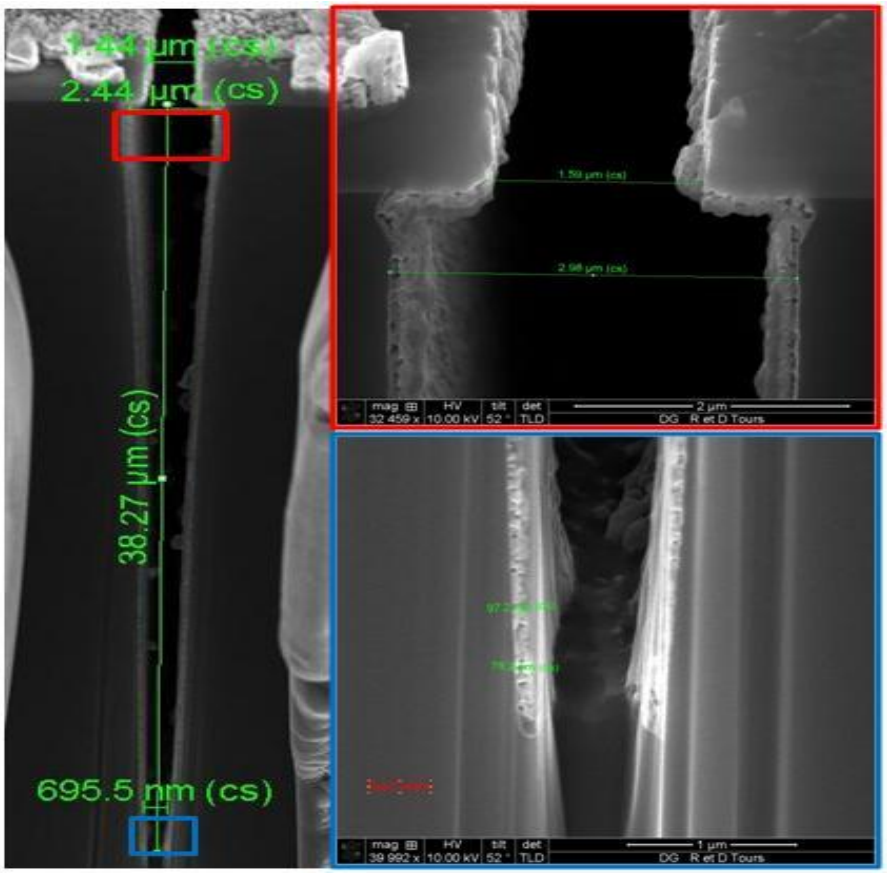

Figure 1: FIB pictures of Cu/SiO_2 deposit : panoramic view and dimension of the trench (left), top of the trench (top right) and bottom of the trench (bottom right)