Comparative Study of Cu-precursors for 3D focused electron beam induced deposition

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It could be of high interest for modern microelectronics to achieve local deposits of pure metal compounds by electron-beam induced deposition (EBID). Nowadays, the resistivities of deposits obtained by this high-resolution local deposition method are still hampered by compositions close to those of the volatile organometallic precursors used, i.e. generally contaminated by carbon or phosphorous. We search for better understanding of the EBID mechanism by varying precursors for copper deposition. The precursors $Cu(hfac)_2$, (hfac)Cu(MHY), (hfac)Cu(VTMS), and (hfac)Cu(DMB) were applied for the deposition process.

With a 25 keV beam at 500pA and exposure times from 1-10min, all precur-sors show growth of several micrometers high tips with diameters on the order of 500 nm. However, differences in vertical growth rates are observed, which we relate to the precursor fluxes.

We will present a physical interpretation of the dependence of growth rates on the vapor pressure of the precursors used, based on a Langmuir adsorption model. Since the vertical growth rate decreases with deposited tip height, we will discuss several mechanisms, among which are surface diffusion, the degree of decompo-sition during growth, and thermal effects.

A 3D self-induced growth process shown in figure 1 will then be presented and discussed.

The chemical deposit composition will be related to the molecular precursor structures. Since the deposit copper contents obtained are not identical and do not respond in the same way to the analysis probes, we will discuss the mechanism involved.

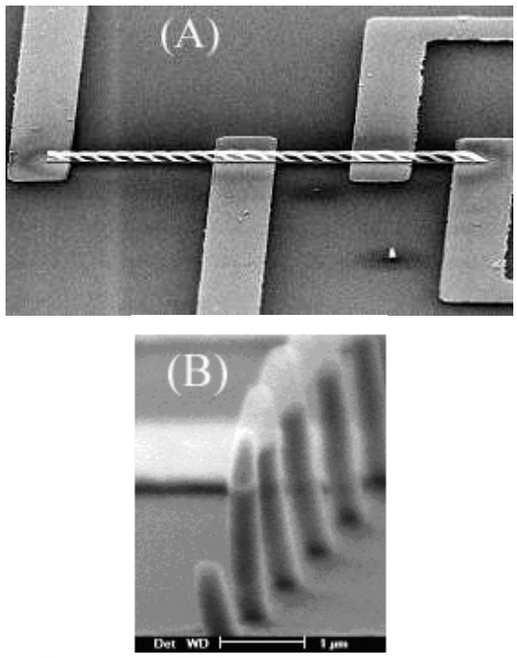

Figure 1 : SEM tilt views of a typical "wave" line deposit obtained by self-induced 3D growth with one single beam scan (from right to left in figure A).