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# Effect of Bath Chemistry on Electrodeposited Cu Morphology Using Thin PVD Cu Seed

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A significant challenge in scaling down Cu interconnect dimensions is achieving adequate barrier and Cu seed coverage within dual damascene structures to enable plated Cu fill. Thin physical vapor deposited (PVD) Cu seed may be discontinuous and not allow for good initiation of plated Cu, resulting in a seam or void at the barrier/Cu interface that can degrade reliability performance.[1] It is of interest to develop Cu electrodeposition processes and chemistries that are tolerant of such non-ideal Cu seeds.

Fundamental studies of the initial growth of electrodeposited Cu on various substrates have leveraged *in situ* scanning probe microscopy methods to characterize the scaling of the growing Cu surface.[2-5] The substrate surface employed in such studies is typically a bulk metal or a relatively thick PVD metal layer. In this study, we evaluate the impact of Cu plating bath chemistry and other variables on the initially deposited Cu film morphology for thin, non-ideal PVD Cu seeds.

Figure 1 shows a blanket 4nm Cu film electrodeposited on a PVD Cu seed nominally 5nm thick for two different acid-sulfate Cu electrolytes. Both chemistries appear to give similar results, with the deposited Cu film appearing more or less coalesced. In Figure 2, the same experiment is repeated, this time using a thinner Cu PVD Cu seed. Though both films are not yet coalesced, the two chemistries clearly yield different deposited Cu particle densities. The influence of bath chemistry, waveform, and secondary seeds (such as CVD cobalt, for example) will be discussed.

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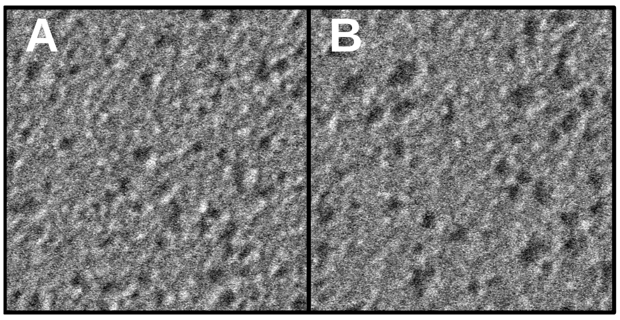

**Figure 1**. Topdown SEM images for 4nm Cu film electrodeposited at ~14 mA/cm$^2$ on 5nm nominal thickness PVD Cu seed. Field of view 1 µm. A thick (~70nm) Ta layer beneath the PVD Cu seed was used to mitigate the terminal effect. (A) and (B) are two different Cu bath chemistries.

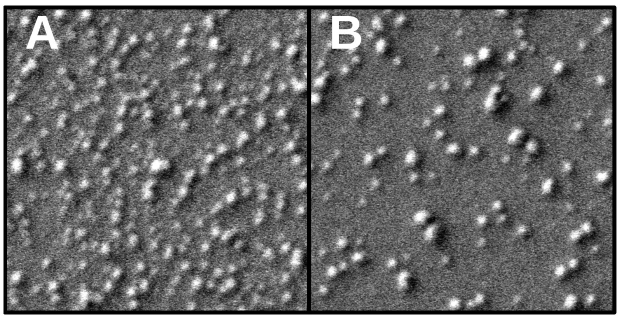

**Figure 2**. Same as in Fig. 1, but for a PVD Cu seed thickness < 5nm. The two different bath chemistries (A) and (B) correspond to those used in Fig. 1.

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