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Plasma Enhanced Chemical Vapor Deposited (PECVD) low-k SiCNH and SiN are the predominant dielectric Cu diffusion caps used by the industry, due to the strong cap/Cu debond energies (1), to prevent Cu exposure to harsh subsequent fabrication process, and to maintain the device interconnect yield and reliability. In recent years, the insertion of a metal cap such as selective Co (2) increases significantly the Cu/metal surface debond energy and subsequently improves the EM performance of Cu/low k interconnects (or BEOL). This paper presents the selective deposition of manganese metal cap for Cu/low k interconnect as a part of IBM-Harvard joint evaluation development with potential use in sub-10 nm BEOL. The selective CVD Mn deposition process and Co metal cap discussed in this paper. The Mn CVD process was developed at Harvard University's Roy Gordon Lab using an oxygen-free Mn-amidinate precursor. Figure 1 illustrates the set up used for the selective Mn CVD process used in this evaluation. A surface treatment (SAM) precursor is used (3) to enhance the Mn selectivity over Cu/SiO2-pSiCOH dielectric. No plasma treatment is required prior to deposition of Mn thus eliminating any plasma damage on the pSiCOH ULK as compared to selective Co process (2). Excellent Mn selectivity Mn (>200:1 Cu/SiCOH) was observed by this novel Mn CVD process and tested with 32 nm BEOL structures, Figure 2. EDX/EELS elemental analysis confirms the excellent Mn selective deposition on Cu, Figure 3. Detailed Cu resistance measurements showed that if the Mn cap is less than 2-2.5 nm thick, the resistance change of Cu is minimal (<2%). Overall, the process shows promising potential to be used together with Mn self-forming barrier liner for sub-10 nm Cu/pSiCOH interconnect.

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References

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Figure 1- The deposition process chemistry for selective manganese deposition.

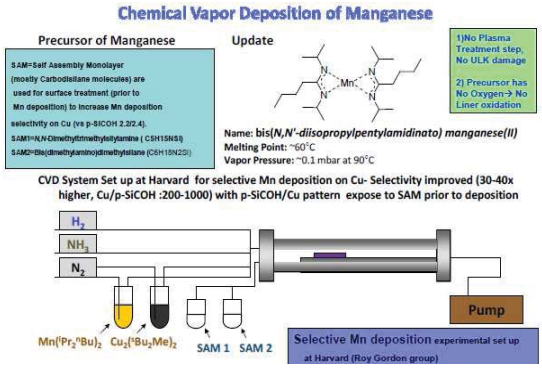

Figure 2- STEM showed excellent selectivity of Mn over Cu/ILD dielectrics.

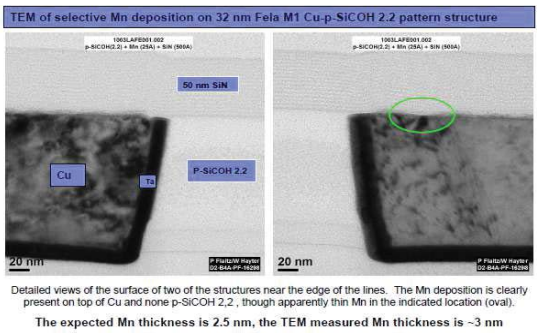

Fig.3- STEM/EDX/EELS compositional analysis confirm excellent Mn selectivity on Cu/pSiCOH k2.2 .