I. Deliverable:

Name: Report on the novel chemistries for copper and barrier E-CMP
Task ID: 425.014
Task Title: Environmentally Benign Electrochemically-Assisted Chemical-Mechanical Planarization (E-CMP)
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II. Technical Results:

Electrochemical studies during polishing of tantalum samples (25 nm films deposited on CDO) were conducted in a home-made ECMP tool, which was interfaced with PARSTAT 2273 potentiostat. A three-electrode setup was used for the electrochemical experiments. The reference electrode was a calomel electrode and the counter electrode (cathode) was a stainless steel (316L) disc (diameter ~ 3.7 cm) to which a perforated polishing pad(diameter ~3.9cm) was affixed. A perforated Rohm and Hass IC1010 pad (with K-grooves) stacked on Suba IV was used for polishing experiments. The polishing pressure was fixed at 0.5 psi.

End point measurement by Potentiodynamic Polarization studies:

The breakthrough of tantalum film to the underlying dielectric during polishing was investigated using an electrochemical technique. A chemical system containing 0.3MDBSA, 1.2M H_2O_2 and 0.1% SiO_2, maintained at pH10, was used for polishing under galvanostatic conditions. The potential (E) of the Ta wafer was monitored as a function of time. The results of experiments carried out at constant applied current densities of 0.25mA/cm^2 and 0.5mA/cm^2 are shown in Figure 1. The potential is constant for certain duration of time and then sharply increases with time. The onset of potential increase indicates breakthrough of Ta and exposure of dielectric material to the solution. Complete removal of tantalum was observed after roughly 155 seconds and 80 seconds, for 0.25mA/cm^2 and 0.5mA/cm^2 applied current density, respectively.

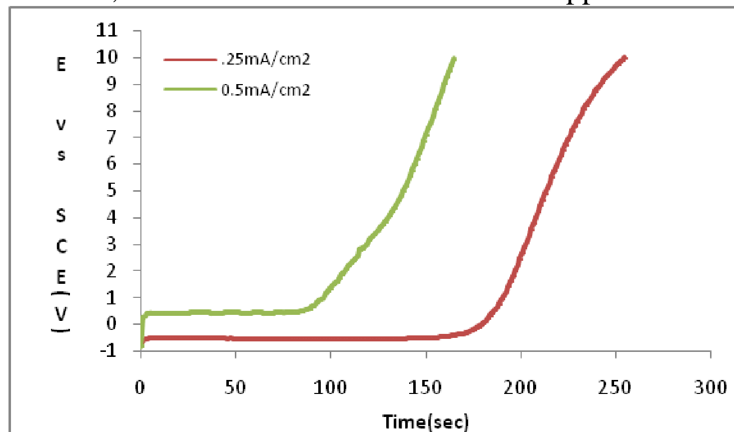

Figure 1: Potentiodynamic polarization studies of Tantalum in 0.3MDBSA+1.2MH_2O_2+0.1%SiO_2 at pH10

Conclusion:

An electrochemical method suitable for the detection of removal of tantalum films deposited on a low-k material in DBSA based chemical systems has been .developed.