Tunable "Soft" Cleaning Chemistries for Enhanced Cu Organic Residue Removal

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As device architecture continues to decrease in size, the mitigation of defects as a result of the CMP process (i.e., scratching, residual particle, consumable particulates, and organic residues) has gained significant attention. Current methods of Cu pCMP cleaning involves the use of harsh alkaline conditions to remove organic residues under polyvinyl alcohol brush scrubbing conditions. However, these conditions are often at the expense of secondary defect generation (i.e., Cu_2O and brush scratching) that are detrimental to device performance.

This work focuses on the development of a "softer" approach to Cu pCMP surveying various additives (i.e., α, β-unsaturated carboxylic acids, carboxylic acids, and unsaturated benzaldehydes) to exploit an "overcutting" mode of BTA removal. Initial results have shown that the implementation of a α, β-unsaturated carboxylic acid (i.e., ItA) compared to an "undercutter" (i.e., MaA) will efficiently remove a BTA film using a "softer" mode of removal. This is evident by the simulated BTA residue removal which can be tracked by the recovery of the anodic region in tafel analysis (Figure 1). It must be noted this recovery is achieved under low corrosion conditions.

Through the implementation of additional modes of interaction (i.e., π-stacking, H-bonding, conformational relationships, etc.) the mode of BTA removal can be finely tuned (Fig.2). However, the addition of excessive π-stacking (i.e., BenA) ability results in a secondary passivation layer. Conversely, limiting the accessibility of the α, β-unsaturated double bond will result in the "undercutting" effects to become the predominant mode of BTA film removal (i.e., FumA and MeA).

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This presentation will correlate the dynamic film removal to additive structure as well as show significant reduction in shear force. Furthermore, initial results have shown that the reduction of an "undercutting" mechanism will decrease the overall shear force and significantly reduce pCMP cleaning defects.

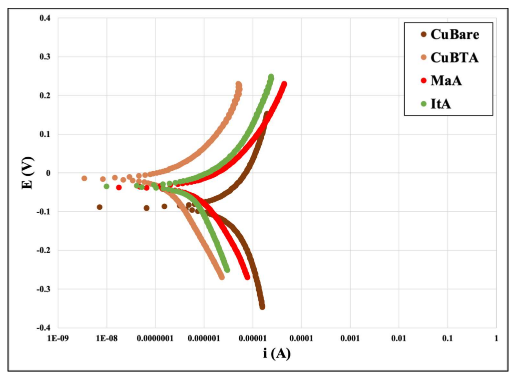

Fig.1 Overcutter (ItA) vs. undercutter (MaA) additives compared to pH 4 DI H_2O with (CuBTA) and without (CuBare) a BTA film.

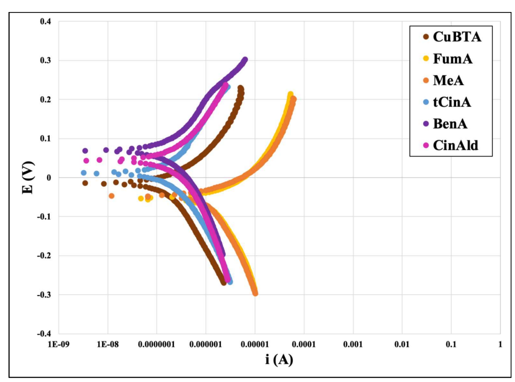

Fig.2 Effects of structure on overcutting ability compared to pH 4 DI H_2O with a BTA Film.

Preference: ☐ Oral X Poster

Topic Area: Defects and Post CMP cleaning