Clarkson University
Department of Chemical and Biomolecular Engineering
SEMINAR

"Environmentally benign Chemical Mechanical Planarization slurries aided by amino acids"

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Chemical Mechanical Planarization (CMP) is one of the important enabling processes in achieving multilevel metallization and incorporation of gate and channel materials. CMP slurries formulated with abrasive particles and chemical additives provide the chemical and mechanical actions that help remove material from the surface of the wafer. However, most CMP slurries are not designed with environment, safety, and health (ESH) in mind. In particular, azole derivatives such as benzotriazole (BTA) and 1, 2, 4-Triazole have been extensively used as corrosion inhibitors for Cu films during polishing. They are considered "emerging contaminants" due to their poor degradation in conventional wastewater treatment systems. Also, the use of BTA leads to contamination of Cu films by forming undesirable hydrophobic organic residues (e.g., BTA and Cu-BTA complexes), making their removal very difficult during cleaning.

Aliphatic amino acids were examined as potential replacements for toxic and problematic azoles in CMP slurries. A representative polishing slurry with 35 nm colloidal silica abrasives, 1wt % hydrogen peroxide (H_2O_2) as an oxidizer, and 0.5 wt% arginine (Arg) as a complexing agent, was used to compare two amino acids (L-glutamic acid (Glu), and L-leucine (Leu)) as potential corrosion inhibitors at pH 8. The electrochemical behavior of polishing slurries aided by the amino acids was characterized using voltammetry on a rotating disk electrode to determine corrosion parameters. Leu-based silica slurry controlled the corrosion potential difference and galvanic current for the Cu/Co couple effectively compared to the Glu. The removal rates (RRs) of both Cu and Co decreased in presence of Glu and Leu with Cu being comparatively lower in case of Leu. Plus, slurries consisting of Glu and Leu showed comparable removal selectivity for Cu and Co. The degradation of the slurry compositions was also monitored using electrochemical oxidation to assess the ease of degradation of the spent slurry, which indicated that Leu is more easily decomposed than benzotriazole during the electrochemical oxidation.

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Hoang Tran is a first year Ph.D. student who joined the Department of Chemical Engineering at Clarkson University in the spring of 2022 and is being advised by Prof. J. Seo. Her research focuses on developing environmentally benign CMP slurries. Prior to joining Clarkson University, she graduated with her Master's degree in Chemical Engineering at Yonsei University.