# Sustainable Innovations in CMP Slurries: Reducing Environmental Impact

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## Why is improving sustainability in CMP important?

- CMP is a crucial but highly contaminated and water-intensive process in semiconductor production.
- It consumes substantial amounts of **chemical solutions** and **UPW** mixed with **particles**.
- Recycling end-of-life consumables from CMP is challenging.



### 1. Environmentally benign CMP slurries: Needs for more benign corrosion inhibitors





Semiconductor Research Corporation

**Environment** Nitrification Inhibition by Azoles



Redox processes converting  $NO_2^-$  and  $NO_3^-$  to  $N_2$ 

#### **CMP Process**

Induced defects caused by Organic residues



Adsorption of BTA on Cu:  $\Delta G^0_{ads,BTA} = -31 \text{ kJ/mol}$ Post-CMP cleaning challenge

### **Need more benign CMP slurry!**

## 2. Recycling of CMP slurries



Spindle

Drain

20 µm

∙Brusł

PAA

20 um



J. Seo, et al.. Colloids and Surfaces A. (2024): 134064

Arunkumar, J. Bankaitis, and J. Seo. J. Ind. Eng. Chem. (2024).

## 3. Life Cycle Inventory Assessment of CMP Slurries





Ravitej





**R. Venkataswamy**, A. McDonald, D. Nevers, L. Vazquez Bengochea, A. Carswell, A. Rossner, and **J. Seo**, ACS Sustainable Chemistry & Engineering (2024)

### **Call to Actions**



Collaboration encouragement: An important part of our mission is to foster a collective effort towards promoting sustainable manufacturing. We encourage **CMP consumable vendors** to join us in this initiative, together driving the industry towards greener practices.



**R. Venkataswamy**, A. McDonald, D. Nevers, L. Vazquez Bengochea, A. Carswell, A. Rossner, and **J. Seo**, CAMP CMP Symposium 2023.