

Integrating Sustainability into Semiconductor Manufacturing: A Comprehensive Approach to CMP Consumables



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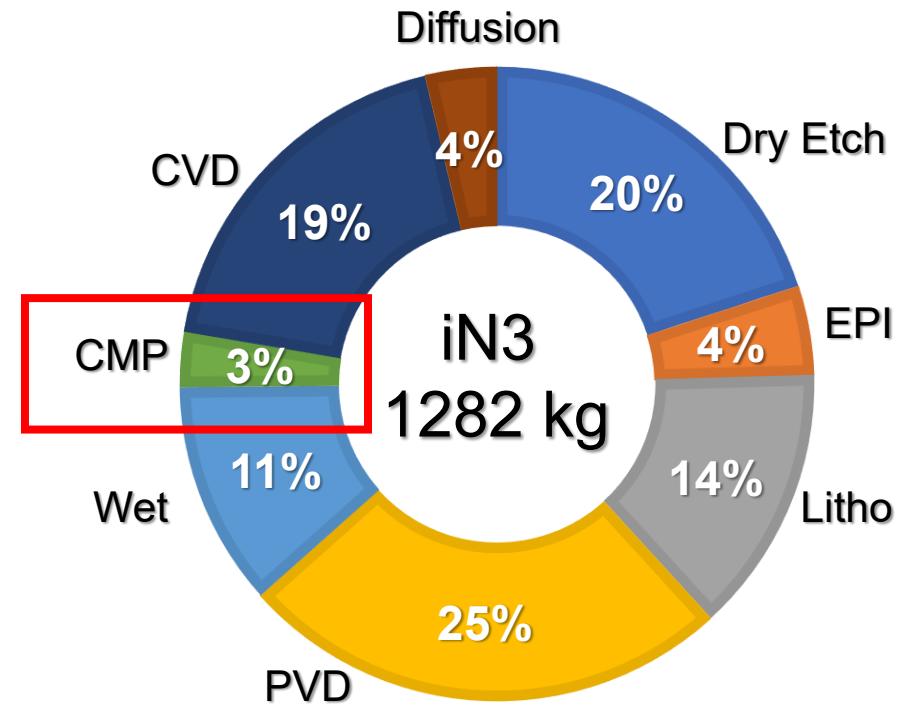


Clarkson™

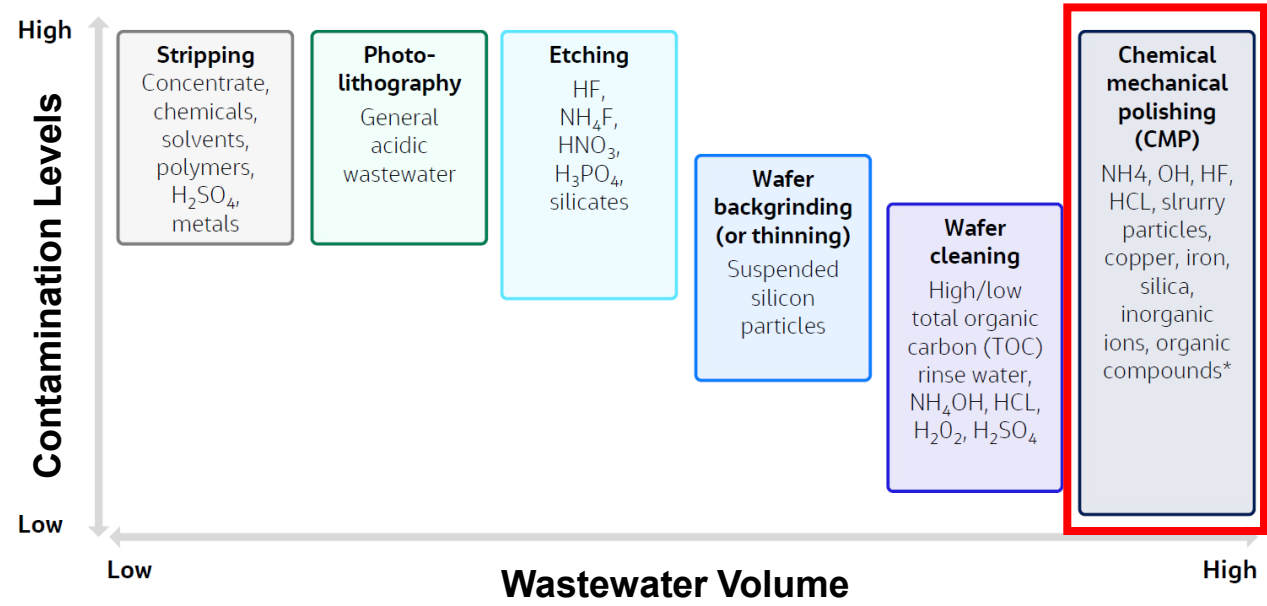
The Chip Industry Has a Problem With Its Giant Carbon Footprint *Bloomberg*

Each new generation of semiconductors requires more energy, water and greenhouse gases to create

CO₂ Footprint Associated with Processes



Wastewater Associated with Processes



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



Hoang Tran

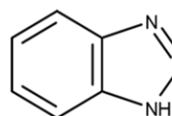


Environment

Nitrification Inhibition by Azoles

1. Nitrification (AOB + AOA)

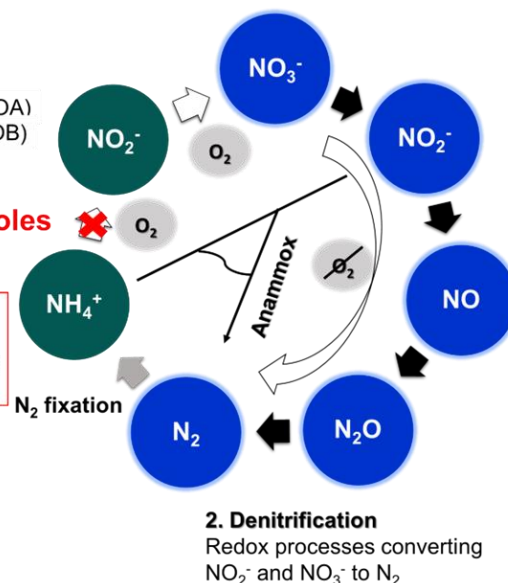
Ammonium oxidizing archaea (AOA)
Ammonium oxidizing bacteria (AOB)



Azoles

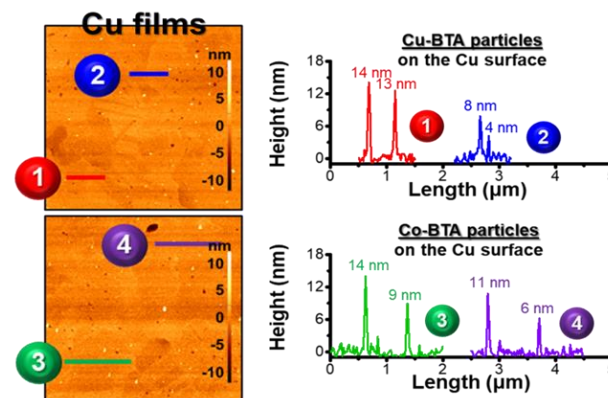
Nitrification Inhibitors

- Bacteriostatic effect
- Inhibit the growth rate of microorganisms and kill them



CMP Process

Induced defects caused by Organic residues



Adsorption of BTA on Cu: $\Delta G_{ads,BTA}^0 = -31 \text{ kJ/mol}$

Post-CMP cleaning challenge

Need more benign CMP slurry!

With Prof. Elizabeth Podlaha-Murphy

Selection of green corrosion inhibitor

Electrochemistry
(Galvanic corrosion,
Physisorption,
Chemisorption,)

Electrochemical
advanced oxidation
process (EAOP)
Monitor stability

CMP Evaluation
(Removal rate,
Cu/Co selectivity)

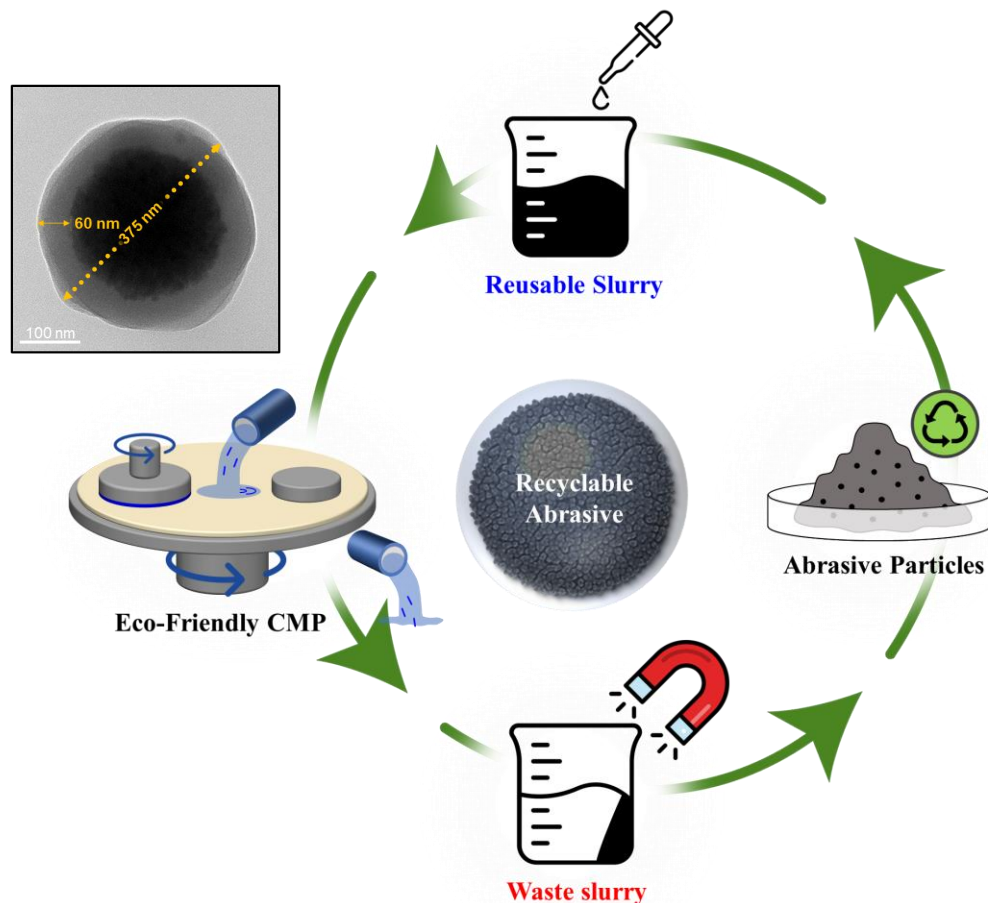
Degradation pathway
of amino acids
(COD, LC-MS,...)

Environmentally Benign CMP slurries!

2. Recycling of CMP slurries



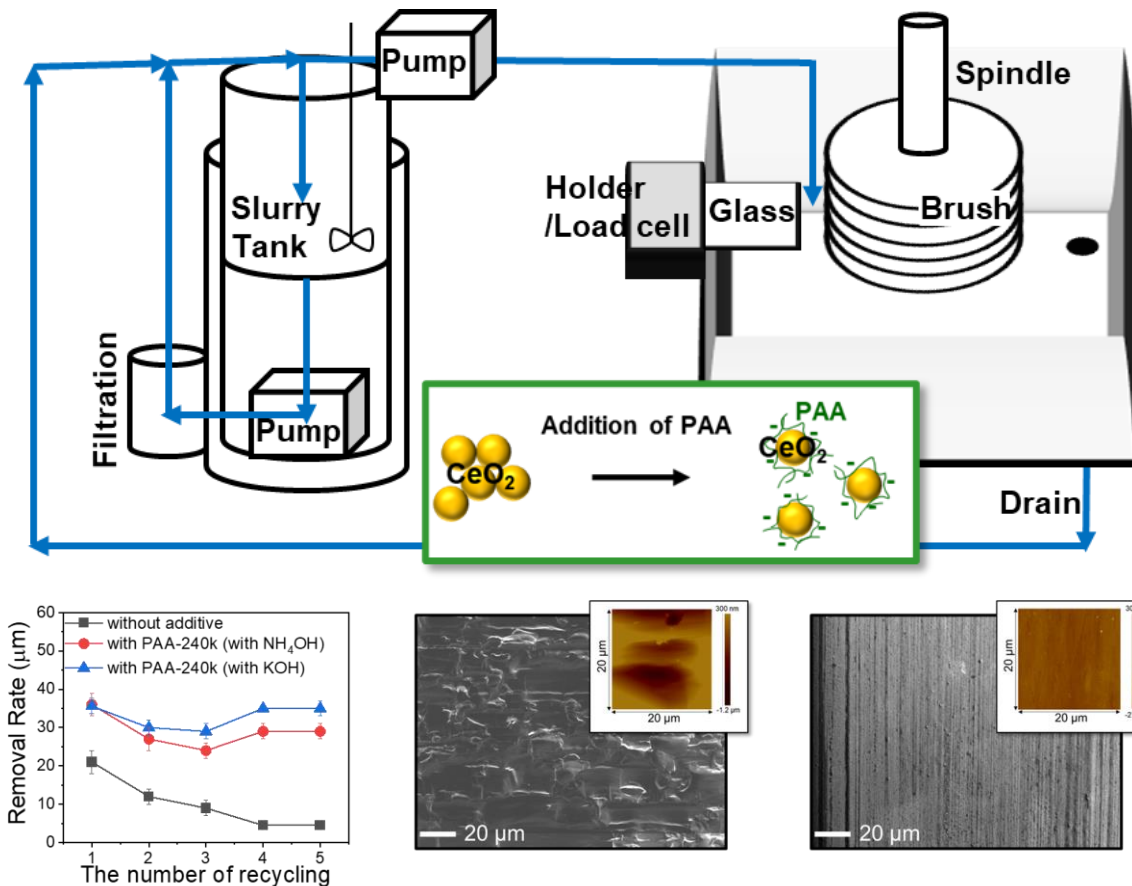
Recovery and Reuse of Magnetic Silica-Coated Iron Oxide Particles for Eco-Friendly CMP



CORNING

Murali Ramu

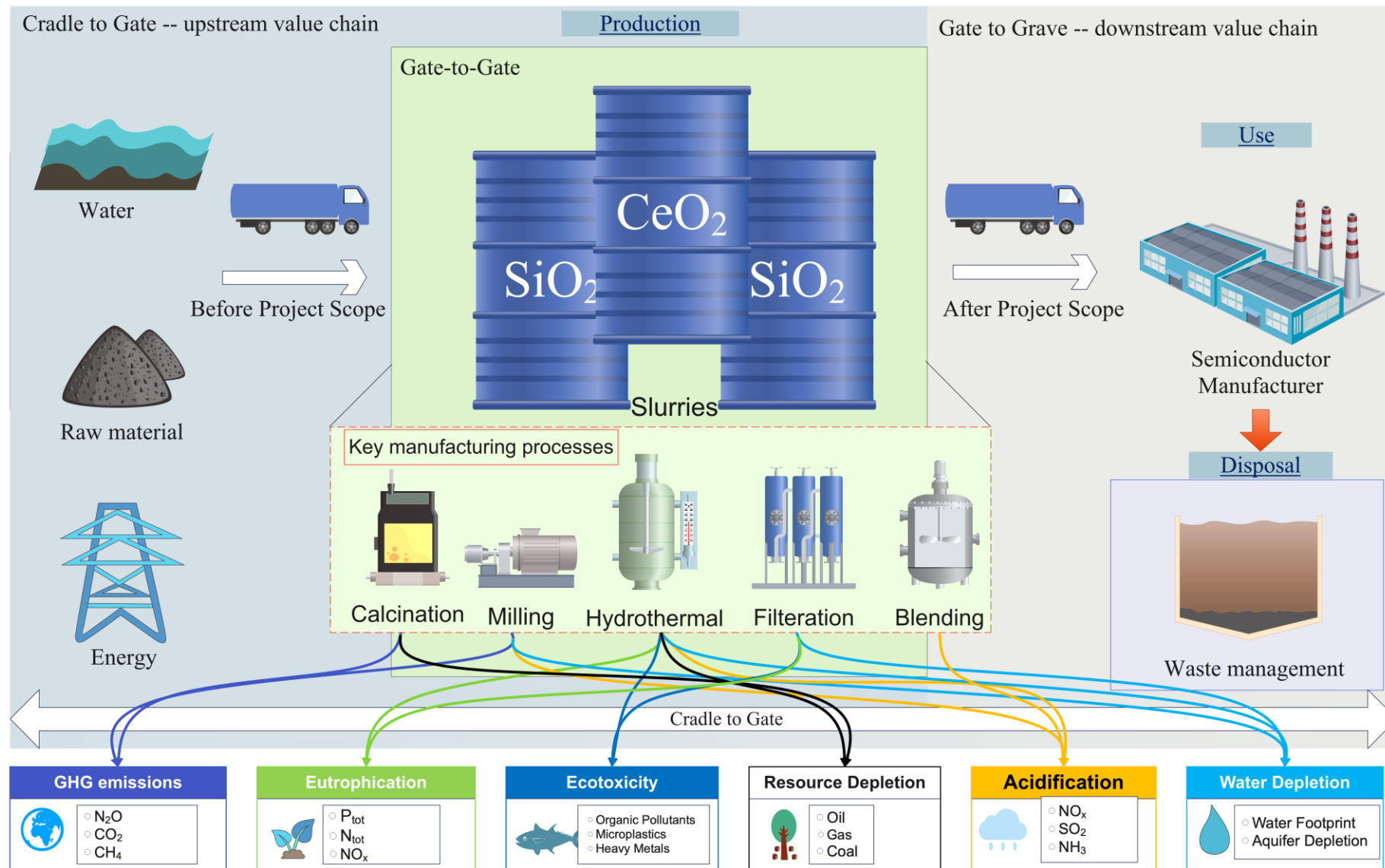
Increased Recycling of Slurries for the Glass Manufacturing Process



3. Life Cycle Inventory Assessment of CMP Slurries



Ravitej

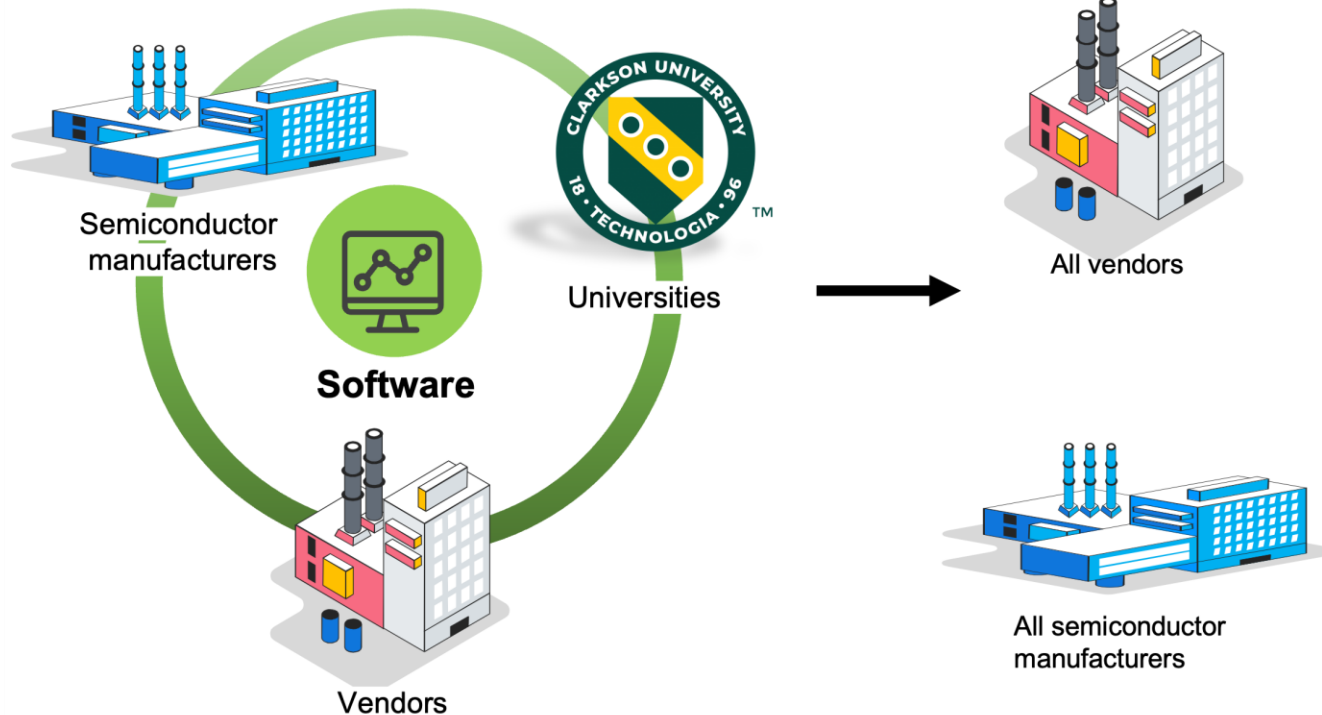


Call to Actions

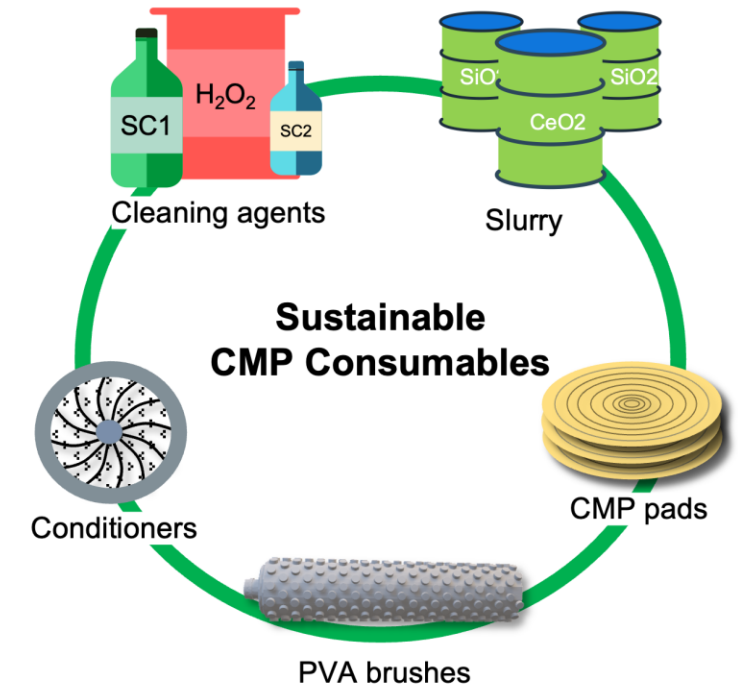


Collaboration encouragement: An important part of our mission is to foster a collective effort towards promoting sustainable manufacturing. We encourage **CMP consumable vendors** to join us in this initiative, together driving the industry towards greener practices.

Collaborators



Greener CMP Industry



Acknowledgments



CAMP
Center for Advanced
Materials Processing



Division of
Science, Technology
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A Division of Empire State Development

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