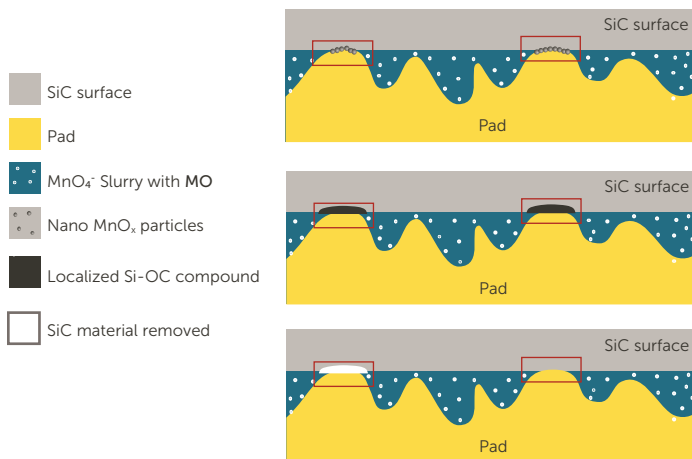


High Performance and Low Cost of Ownership (CoO) Silicon Carbide (SiC) CMP Solution

Helin Huang, Chenxuan Li, Pankaj Singh, Sridevi Alety, Sunny De, Hemanth Gudi, Niraj Mahadev, Rajiv Singh, Shengyu Jin, Loriz Aguilar—Entegris, Inc.

INTRODUCTION

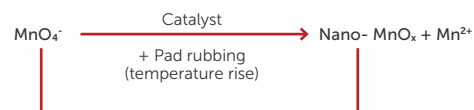
With the evolving ecosystem of Silicon Carbide (SiC) devices, achieving high performance and low cost of ownership (CoO) in SiC CMP solutions has become crucial in the manufacturing process. At Entegris, we have developed a comprehensive SiC CMP solution that delivers high removal rates (RR), excellent surface finishes, and low CoO.



HIGH-RATE SiC SLURRY

In high-rate slurry system, we have developed our latest catalyst technology. During the CMP process, the catalysts are essential not only for generating in situ nano- MnO_x particles during polishing, but also for driving the oxidation of SiC into a soft, removable oxide layer that enables efficient material removal.

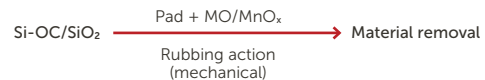
Step 1: In-Situ nano- MnO_x catalyst formation



Step 2: Oxidation of SiC into oxide layer



Step 3: Removal of the oxide layer by pad rubbing with MO and MnO_x

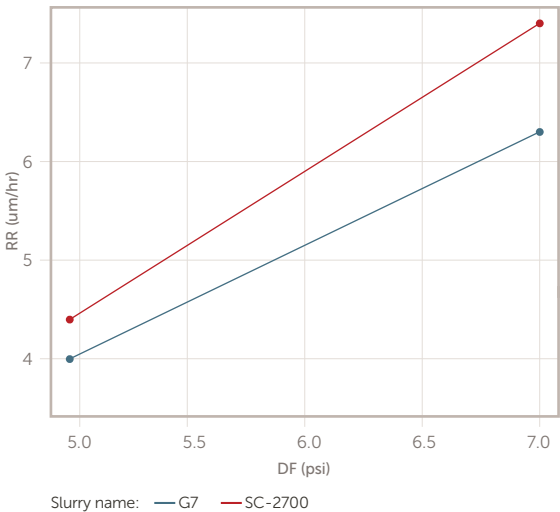


Innovative Catalysts Formulation Enable High Throughput

With the new catalyst technology, we have developed our latest SC-2700 high-rate abrasive free slurry platform. In this system, we were able to achieve 17% higher Si face material removal rate than G7, reaching 7.4 $\mu\text{m/hr}$ at 7 psi condition. Under high PV conditions (1100-1200), >10 $\mu\text{m/hr}$ has been achieved on 8" wafers. The abrasive-free system also provides easy mixing and handling benefits.

SC-2700	
Abrasive	Abrasive free
Slurry pH	2-3
RR (um/hr) @ 7 psi	7.3 (+17%)
Roughness (Ra, nm)	0.14
Defectivity	Scratch free

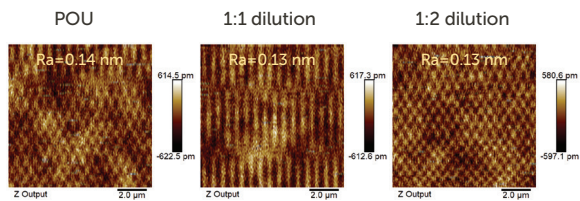
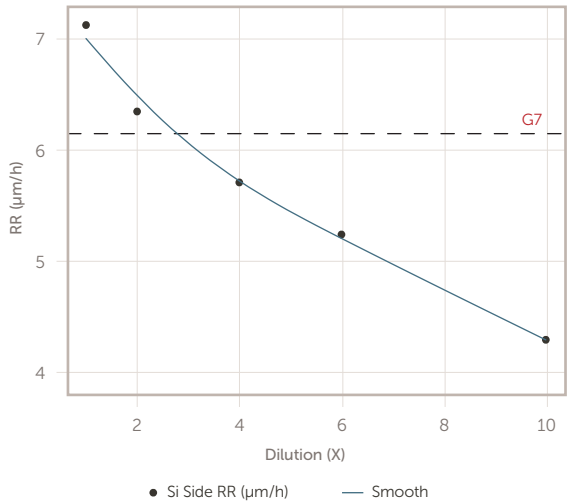
RR (um/hr) vs. DF (psi)



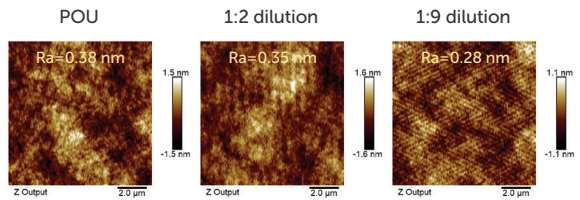
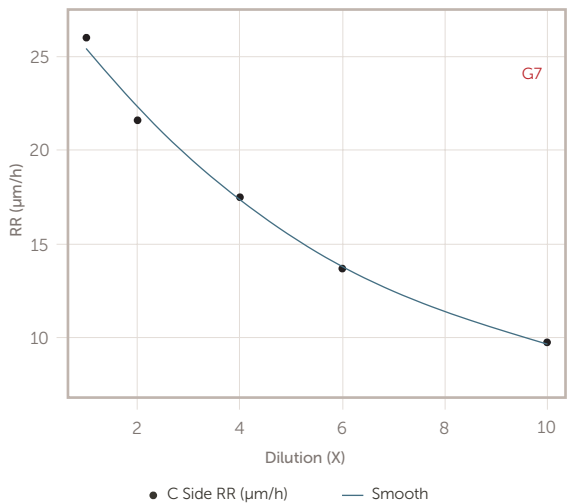
Extraordinary Dilution Performance

SC-2700 maintains high RR under dilution condition, significantly reduces CoO. At 3X (1:2) dilution, SC-2700 shows 0.98X of G7 Si face RR and 0.86X of G7 C face RR. The diluted slurry maintains good surface finish.

Si Side RR (μm/h) vs. Dilution (X)



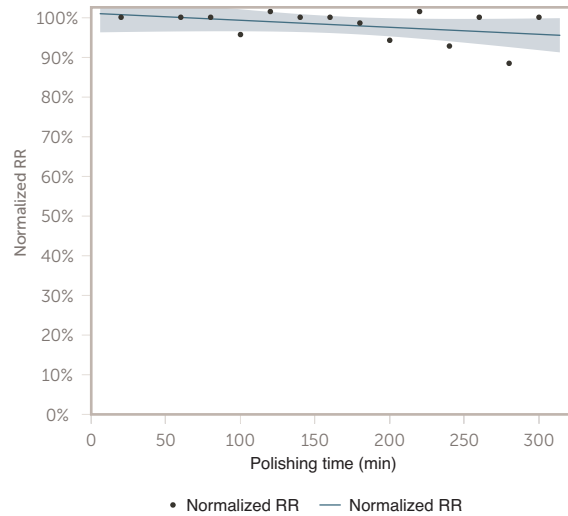
C Side RR (μm/h) vs. Dilution (X)



Excellent Recyclability

The specially designed buffering system effectively counteracts pH drift caused by polishing waste, ensuring a consistently high removal rate during the recycling process. Almost no RR drop even after 300 mins polishing (10% replenish rate).

Normalized RR vs. Polishing time (min)

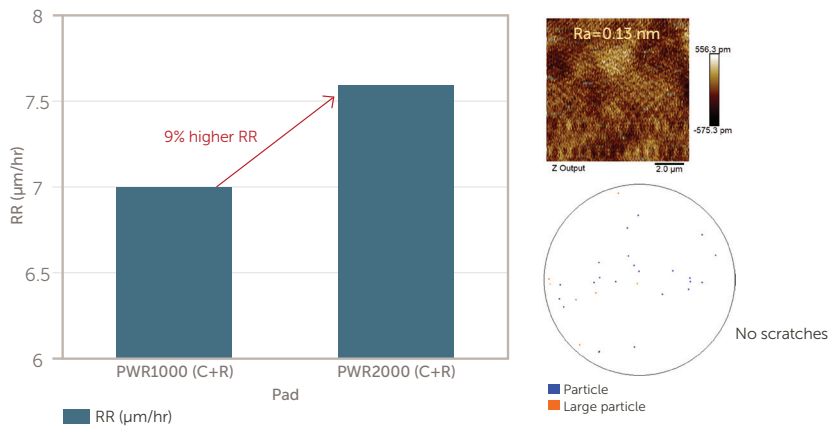


PAD SYNERGY FOR HIGH-RATE SLURRY

Our proprietary pad (PWR series) provides synergistic performance with our slurry, enhancing RR and surface finish, and offers excellent pad life (>30 hours of polishing time). By optimizing the pad design, the RR for high rate SiC slurry can be further increased by 9% with PWR2000 pad. It can also provide better surface roughness and scratch free surface finish.

Epic Power Thermoplastic SiC Pads PWR1000/PWR2000

RR ($\mu\text{m/hr}$) vs. Pad



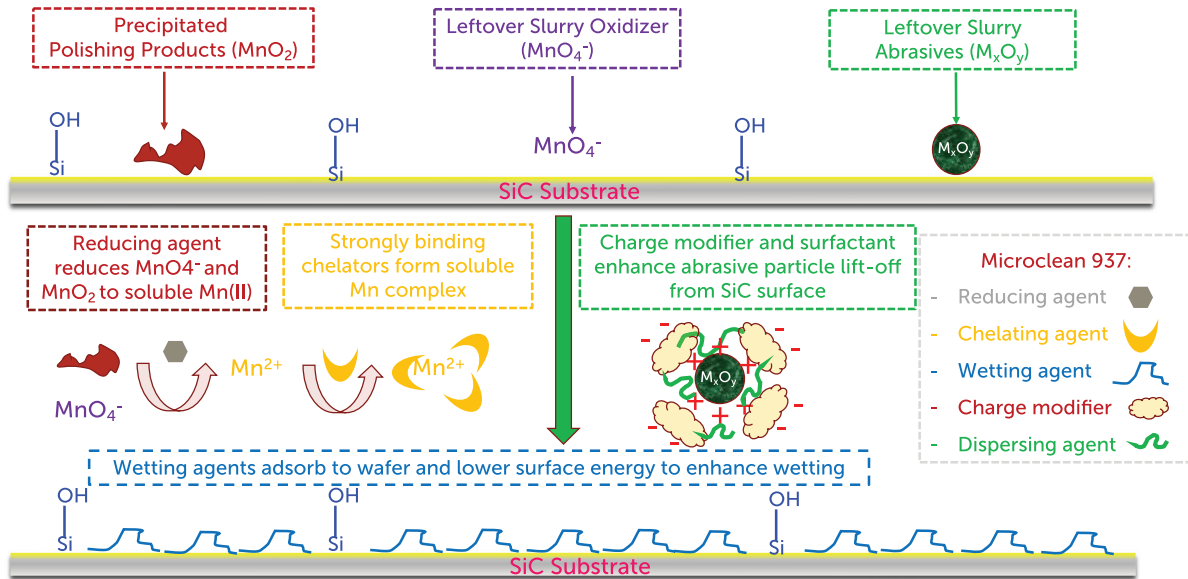
Pad	Ra (nm)	Total particle defect counts
PWR1000 (C+R)	0.14	57
PWR2000 (C+R)	0.13	42

- Outstanding pad property control resulting from continuous foaming manufacturing process
- Excellent material toughness for longer pad life
- Pad diameters fitting a variety of polishing tools up to 46"
- Consistent high removal rate throughout pad life
- Significantly improved defectivity, less pad staining
- Lower polishing temperature
- Resistance to chemical attack

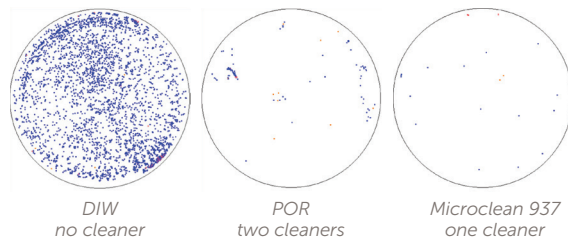
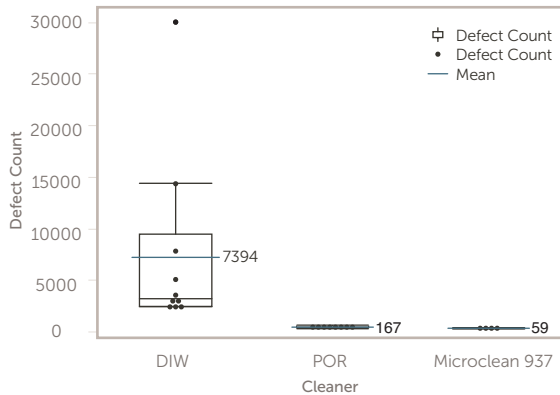
POST-CLEANING TECHNOLOGY

One Cleaner for Both Pad and Wafer pCMP Cleaning

Microclean 837 is a one-pack, H_2O_2 -free cleaning chemistry designed for both post-CMP SiC wafer cleaning and pad cleaning/conditioning. It delivers superior performance compared to POR PCL185/186/565 solutions, offering a simplified and more effective cleaning process.



Defect Count and Mean (Defect Count) vs. Cleaner



Electrical results for TitanKlean 9C using a 45 nm pitch test structure with CD lines of 22 nm and more. Significant yield improvement for D04 (TitanKlean 9C:H2O2 1:3, 50°C, two minutes) and D05 (TitanKlean 9C:H2O2 1:9, 50°C, two minutes) vs. no clean D06 (no clean): 90% vs. 50% for CD lines of 22 nm.

SUMMARY

In our newly developed slurry system, the next-generation catalyst exhibits significantly higher catalytic efficiency, achieving more than twice the removal rate (RR) compared to the previous generation catalyst. The specially designed buffering system effectively counteracts pH drift caused by polishing waste, ensuring a consistently high removal rate during the recycling process. With its optimized formulation, the slurry system delivers high RR, excellent surface finishes, good recycling ability, and high dilutability. Our proprietary pad (PWR series) provides synergistic performance with our slurry, enhancing RR and surface finish, and offers excellent pad life (>30 hours of polishing time). Additionally, our recently developed one-pack peroxide-free cleaner further improves surface defectivity. Overall, with our high removal rates, excellent surface finishes, and low CoO SiC CMP solution, we expect customers to see at least a 2X reduction in their CoO for the SiC CMP process.

FOR MORE INFORMATION

Please call your Regional Customer Service Center today to learn what Entegris can do for you. Visit [entegris.com](https://www.entegris.com) and select the [Contact Us](#) link to find the customer service center nearest you.

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