Advanced Diamond Solutions

## **PolyCrystalline Diamond Conditioners for Dressing CMP Pads: An Enabling Technology for Manufacturing Future Semiconductor Devices**

CMP Users Group April 12, 2006

James C. Sung Cheng-Shiang Chou Barnas G. Monteith Michael Sung



#### Future Needs of the Semiconductor Industry

**New design challenges for CMP conditioning:** 

- Features are becoming very small (< 65 nm)</li>
- Copper is soft; dishing problems
- Low-k dielectrics are fragile
- Slurries can corrode conditioners; contaminants
- Diamond fall-out a continual problem
- Surface variations from conditioners reduce process repeatability

Advanced Diamond Disk (ADD): Revolutionary polycrystalline diamond pad conditioner with improved polishing and uniformity characteristics

- Cutting tips formed directly from the PCD conditioner substrate
- Precise control over the cutting tip patterning and height variation
- Removal rate uniformity, extended pad life, and lower defect rates



### **CMP Diamond Disk Evolution**

1 st Gen





# **Tip Height Variation & Cutting Patterns**





### Patterning Polycrystalline Diamond Substrate







# **Conditioner Design Specifications**

	Current Gen	ADD
Diamond Leveling	$> 50 \ \mu \mathrm{m}$	$<$ 20 $\mu$ m
Dressing Rate	$> 50 \ \mu \mathrm{m/Hr}$	$<$ 20 $\mu$ m/Hr
Working Crystals	< 10%	> 90%
Diamond Shape	Irregular	Symmetrical
Diamond Angle	$>100^{\circ}$	< 90°
Dressing Stress	Large (Tearing)	Low (Cutting)
Pad Life	Short	Long
Disk Life	Short	Long
Asperity	Random	Uniform
Uniformity	Low	High



#### Consistent Removal Rate and Polish Uniformity





### Pad Cut Rate vs. Polishing Rate





#### Control Over Cutting Tip Geometry and Height Variation









### **Dressing Rate as a Function of Tip Geometry**





# **Controlled Asperities for Process Uniformity**





### Surface Refinishing to Reclaim Used Conditioners





#### Summary of Benefits

- Controlled PCD cutting tip geometry and protrusion results in excellent pad dressing
- Consistent and efficient removal rates combined with gentler polishing is ideal for small critical features and for process uniformity
- Improved process performance allows for lower defect rates and increased wafer yields
- High PCD cutting tip retention means absolutely no diamond dropout
- Customizable cutting tip geometries means these pads can work for any wafer polishing specification
- Extended pad life and novel ability to refinish cutting tips on each pad leads to increased product life and reduced cost of ownership
- Pure diamond substrate conditioner results in superior chemical resistance to acidic slurries and compatible with tungsten and copper processes



### For More Information

# Advanced Diamond Solutions, Inc. www.advanceddiamond.com msung@advanceddiamond.com