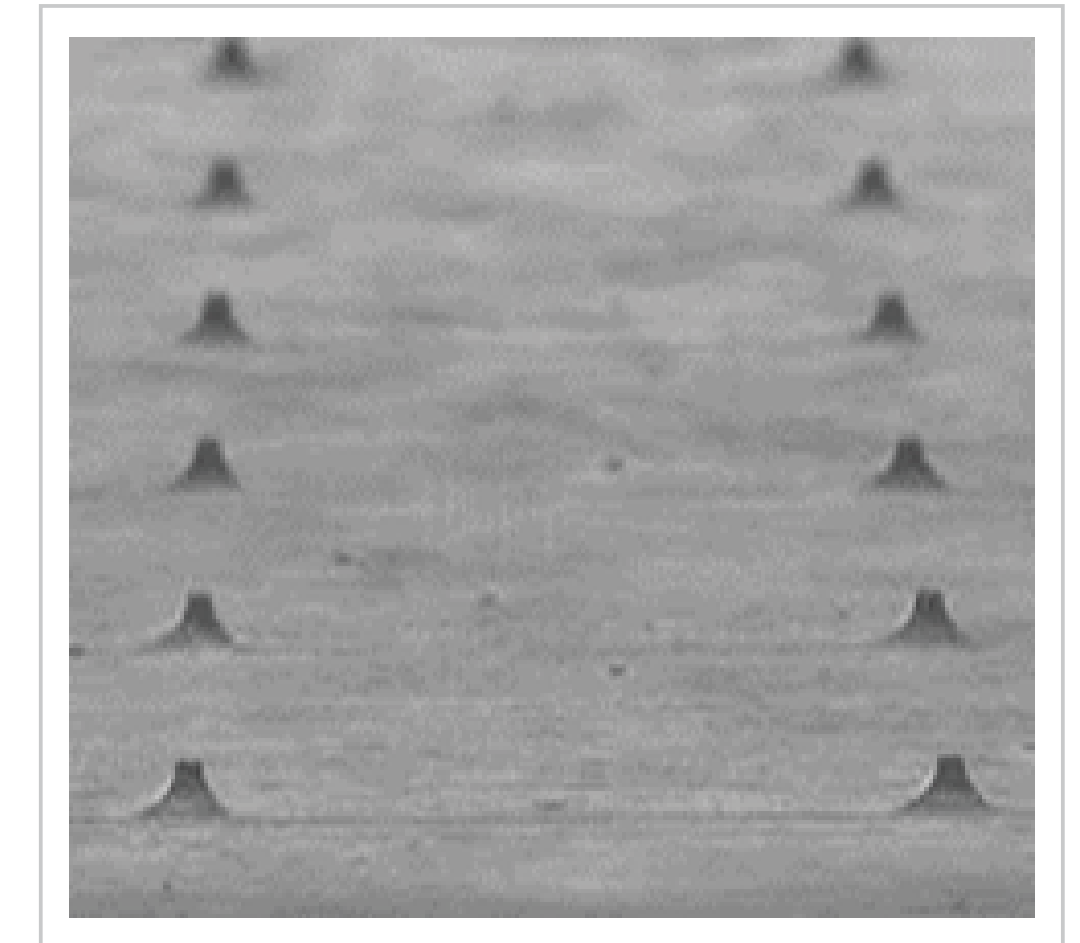


CMP PAD CONDITIONER (CVD)



Technology of CVD Diamond Coated Pad Conditioner "Engineered Quality Control"

- Chemical stability : Chemically inert surface
- Excellent disk flatness : Uniform tip size & tip exposure
- Working diamond design : Pad Cut Rate(PCR) & Wafer Removal Rate(WRR) tuning by tip geometry design exposure, shape, etc.
- PCR sustainability : Constant and consistent PCR and WRR over polishing time



Features

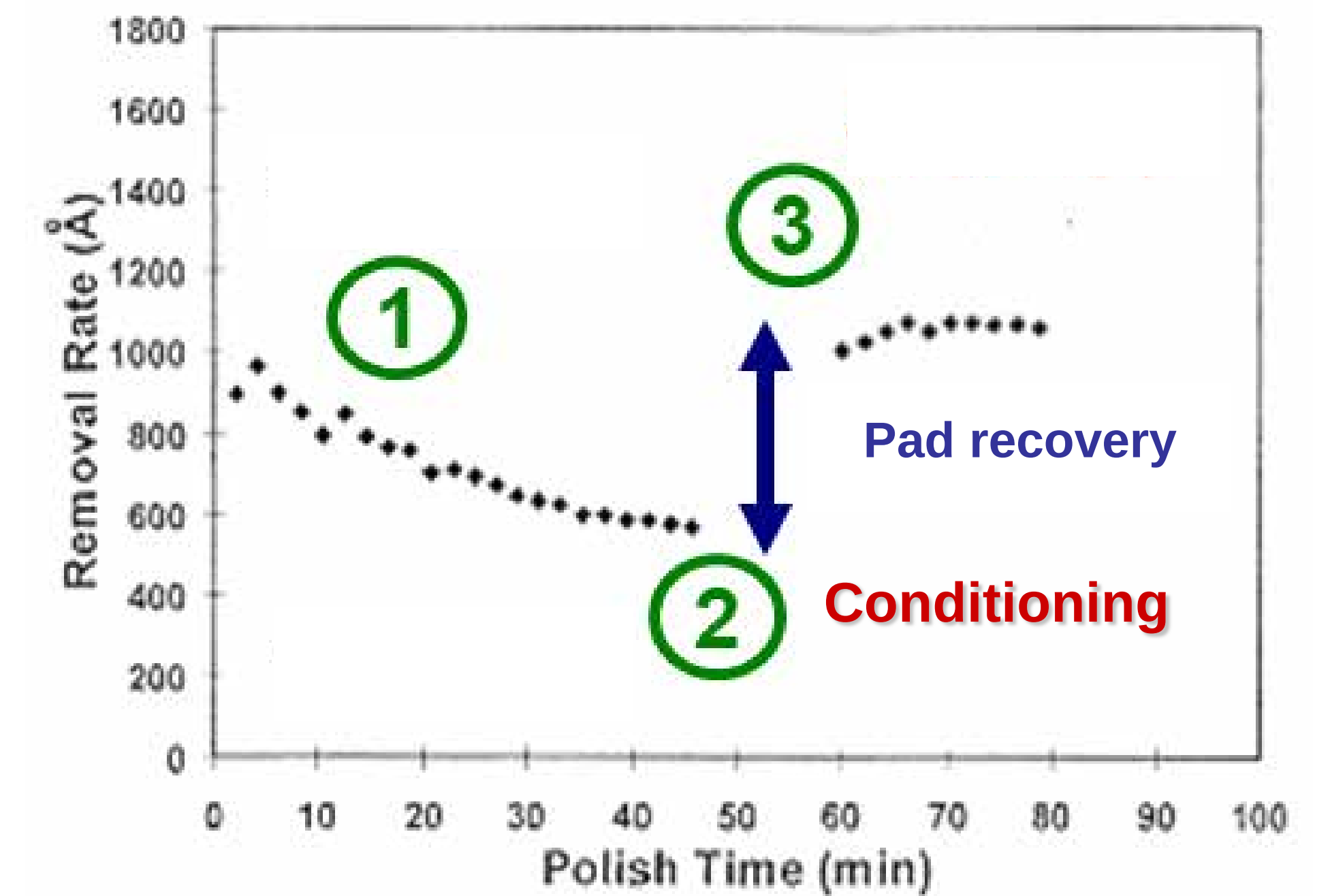
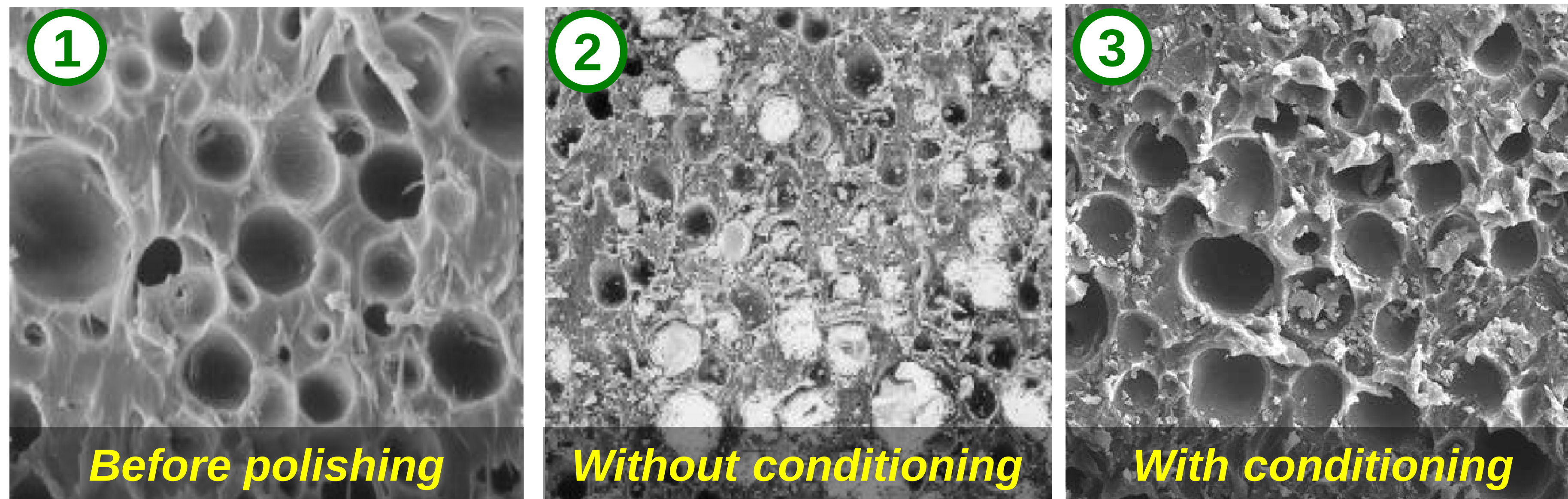
- Various patterns can be arranged with CVD diamond coated tips
- Apex of the CVD diamond coated tip is flat face
- Allows to engineer the critical pressure applied to each tip for pad conditioning
- EHWA has a patents on the tip size and number for pad conditioning
- Shape of the apex where contacts with pad has not changed over conditioning time, which result in consistent pad cut rate
- Pad cut rate is constant

CMP PAD CONDITIONER (CVD)

Role of CMP Pad Conditioner

* Y. Moon, Mechanical Aspects of the Material Removal Mechanism in Chemical Mechanical Polishing, UC Berkeley (1999)

* S.H. Li, R.O. Miller, Chemical Mechanical Polishing in Silicon Processing, Vol. 63 pp. 29-31, Academic Press, (2000)

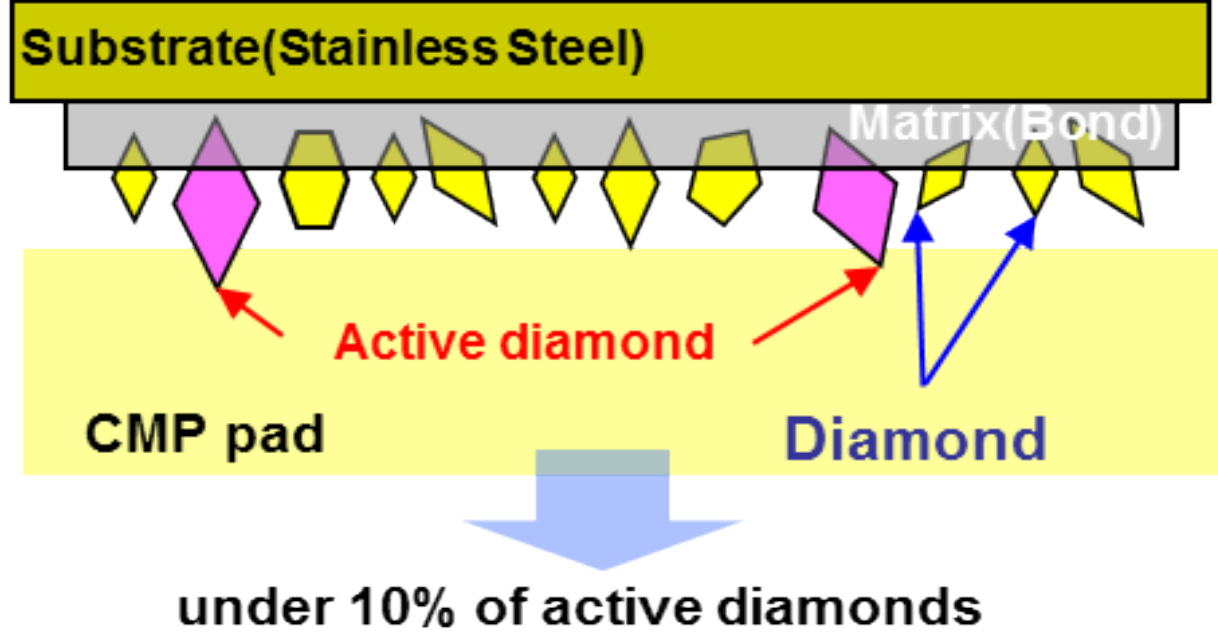
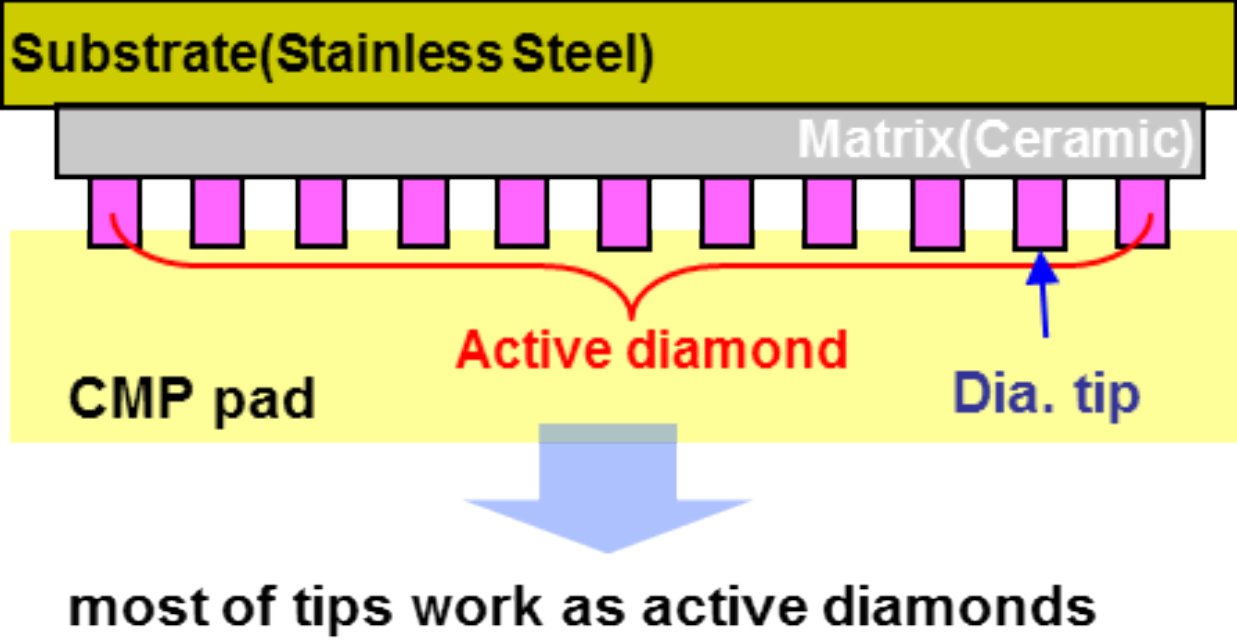
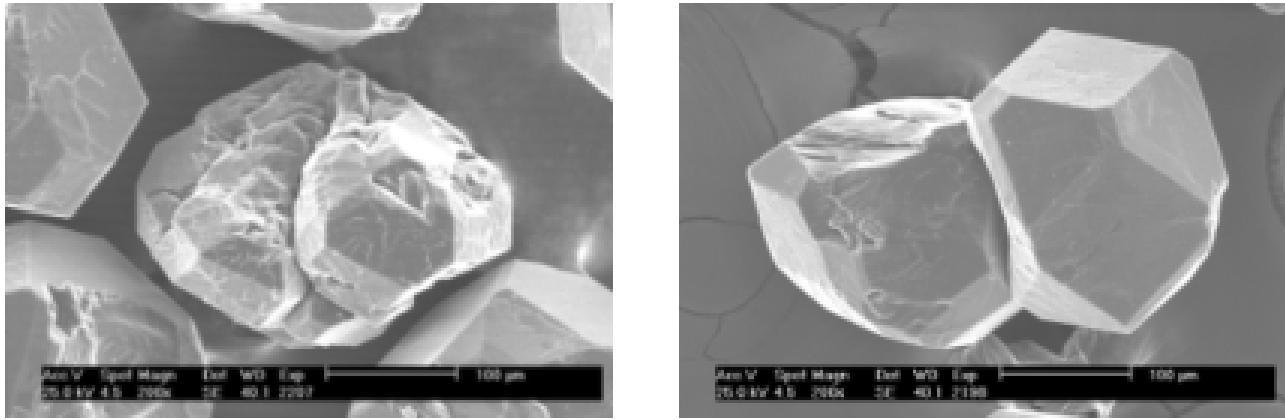
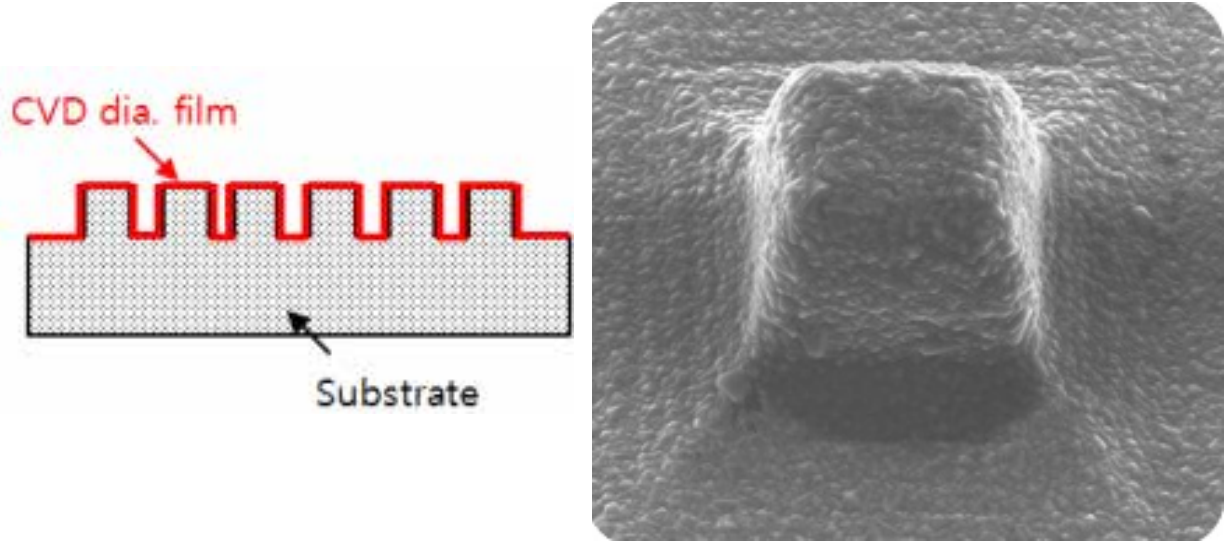
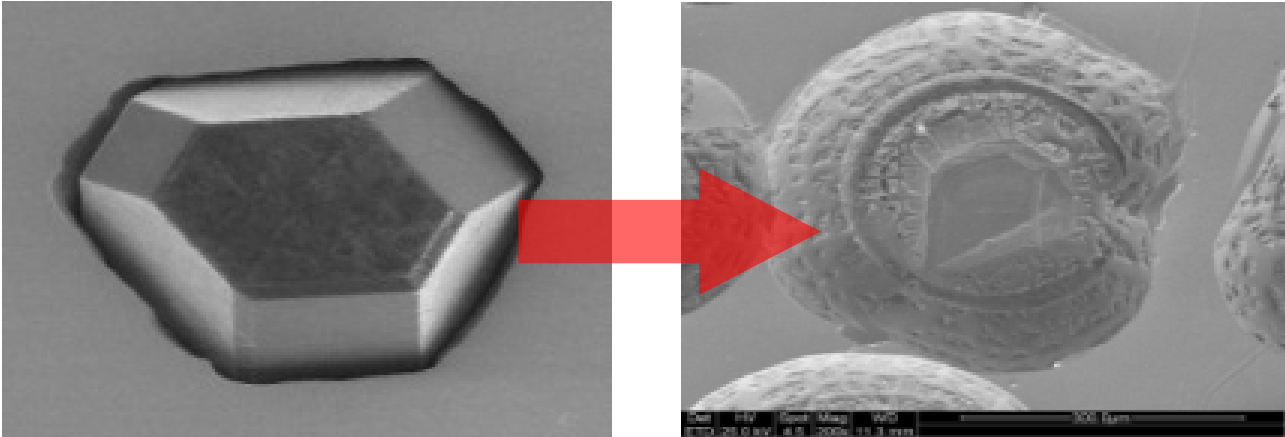
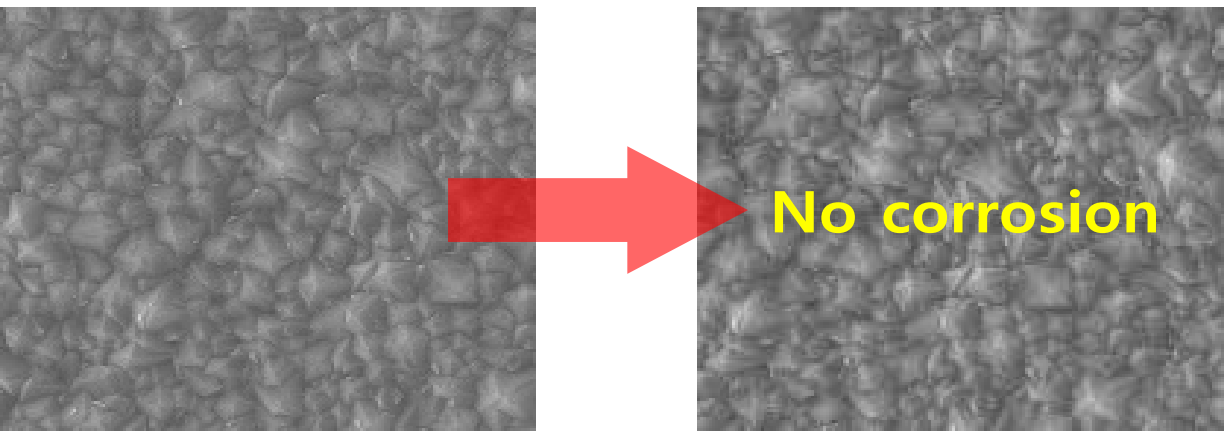


- Prevent pad glazing during CMP
- Guarantee defect/topography control
- Maintain high material removal rate
- Sustain good wafer uniformity

- Pad lifetime extension
 - CMP process optimization
 - Yield improvement
- Best CMP Process!**

CMP PAD CONDITIONER (CVD)

EHWA CVD CMP Conditioner Technology

	Conventional disk (Electroplated)	EHWA CVD disk
Active diamonds or Tip numbers	 under 10% of active diamonds	 most of tips work as active diamonds
Flatness	$> 20\mu\text{m}$	$< 6\mu\text{m}$
Potential Risk 1. Diamond breakage	 Crack diamond Twin diamond Metal (Ni-base)	 No Breakage of Ceramic Tip
2. Diamond fallout	 Crevice corrosion Diamond fallout Bonding metal corrosion	 Before dipping After 10% H2O2 320hr CVD surface : No corrosion

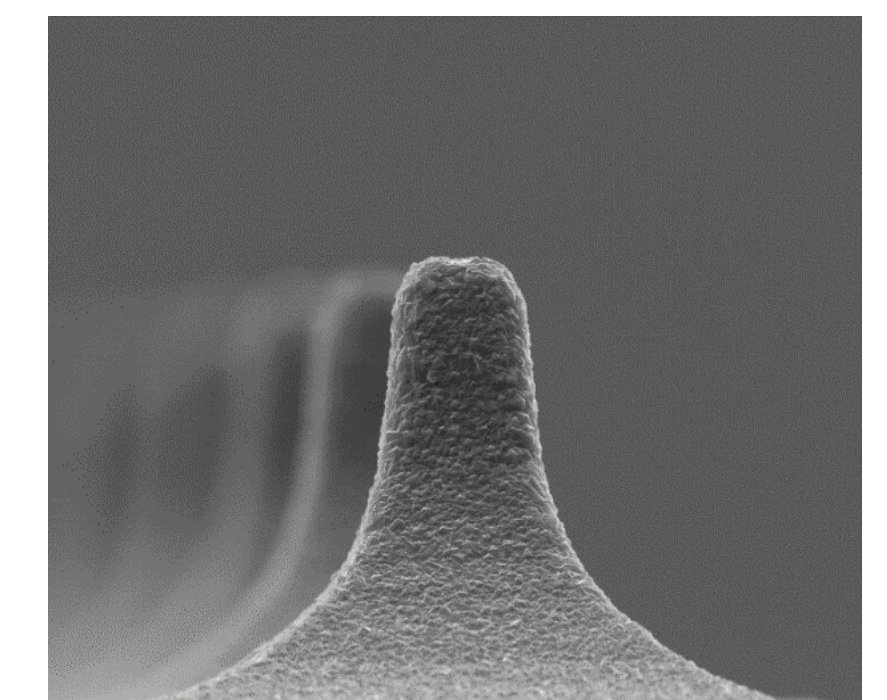
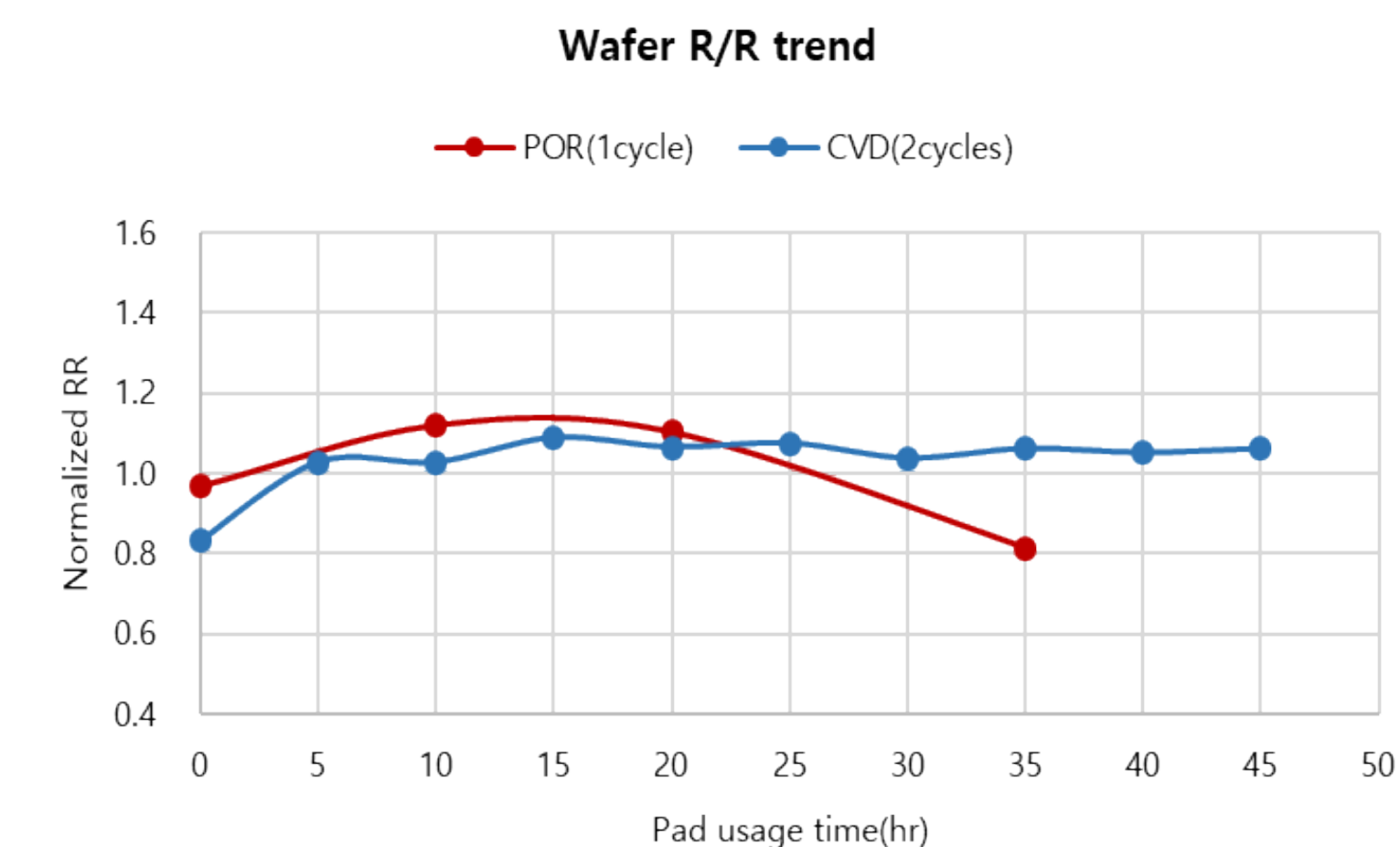
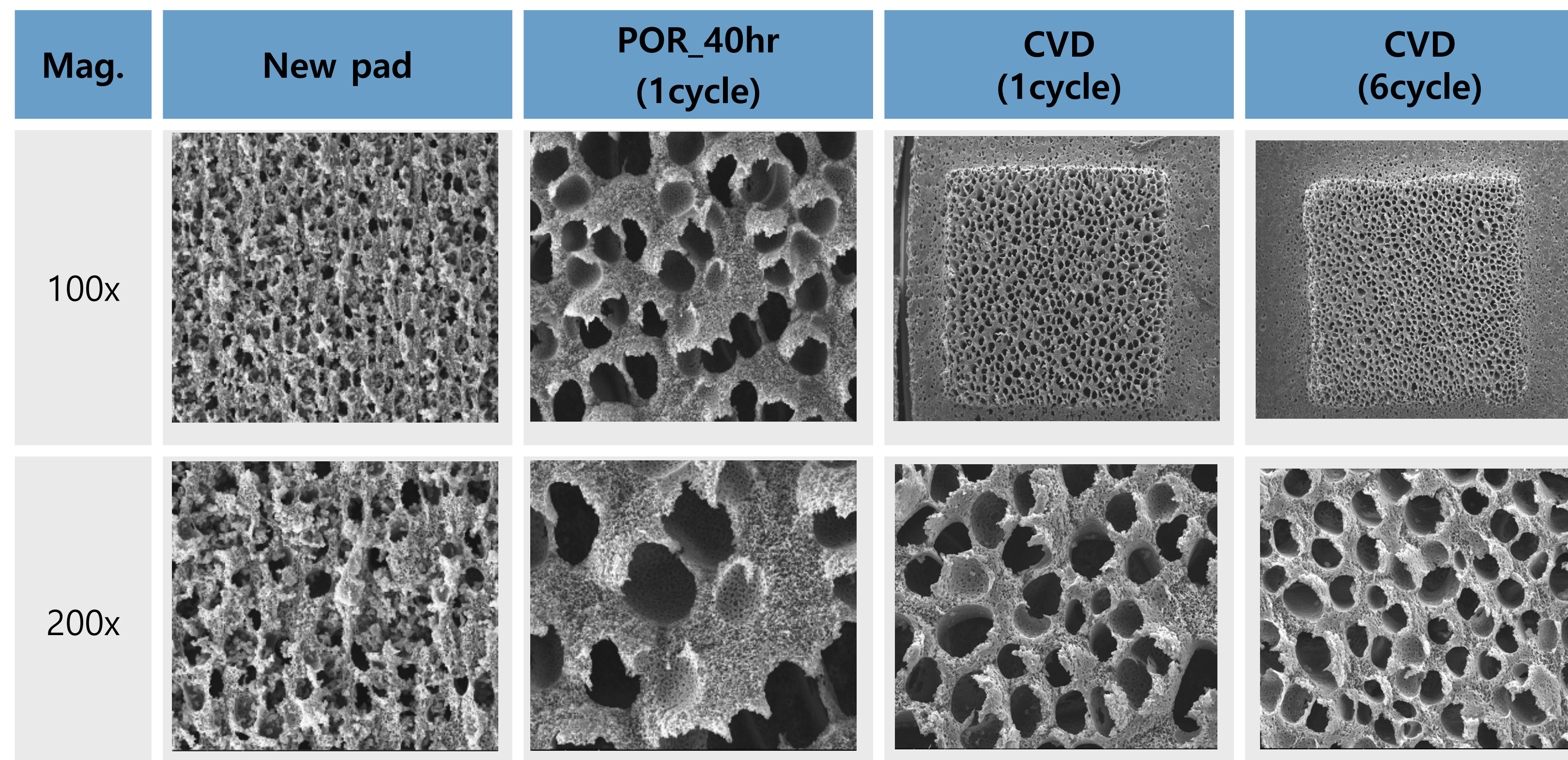
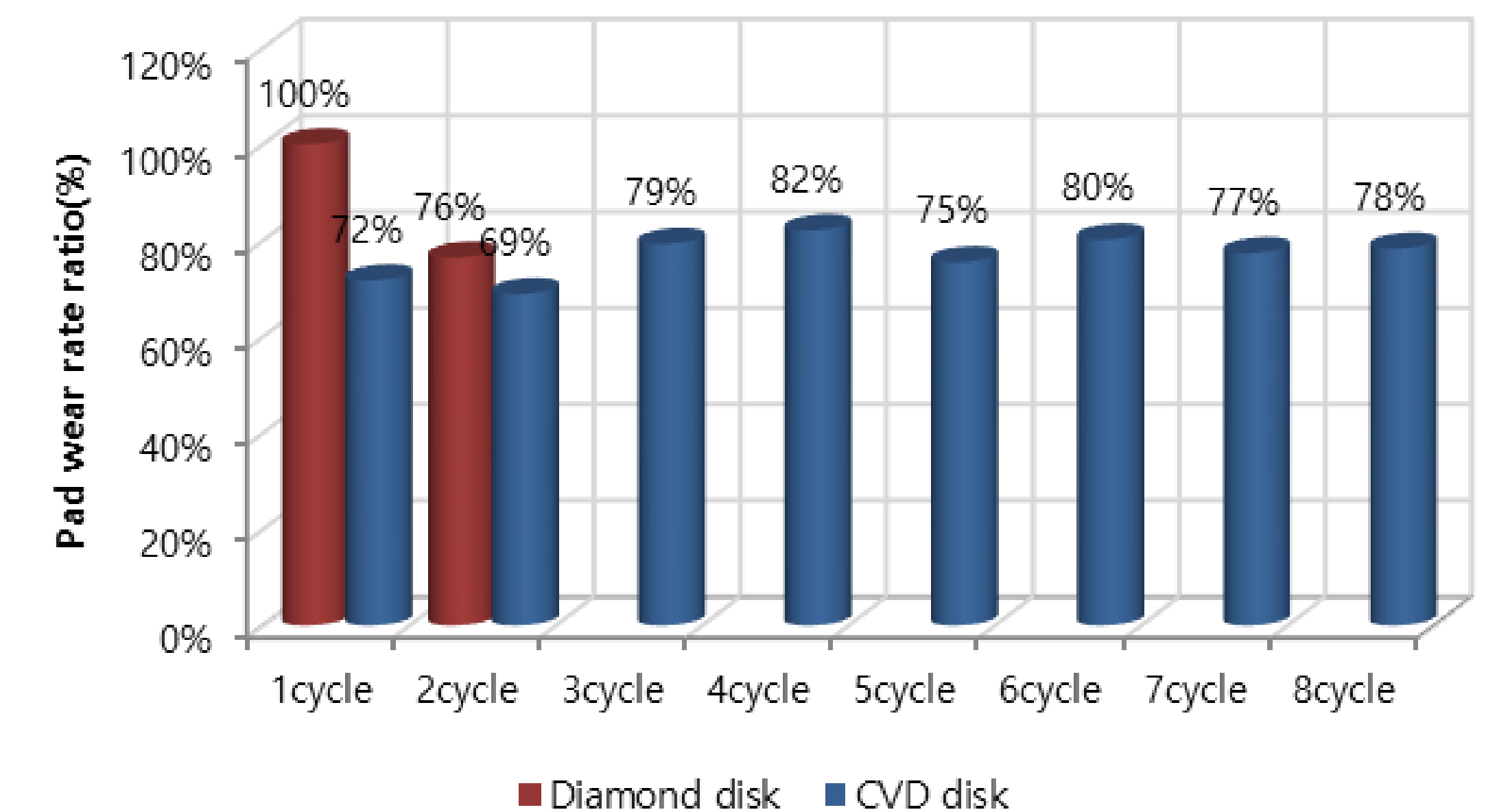


CMP PAD CONDITIONER (CVD)

Technical excellency for sustainability by CVD disk

- 1) Excellent wafer MRR sustainability due to consistent diamond tip contact area
- 2) Longer pad lifetime from minimum and adequate pad wear rate
- 3) Lower cost of consumable (CoC) per wafer from multiple pads enablement with minimum diamond wear.

Pad wear rate ratio trend
(Diamond disk : 2pads/disk, CVD disk : 8pads/disk)



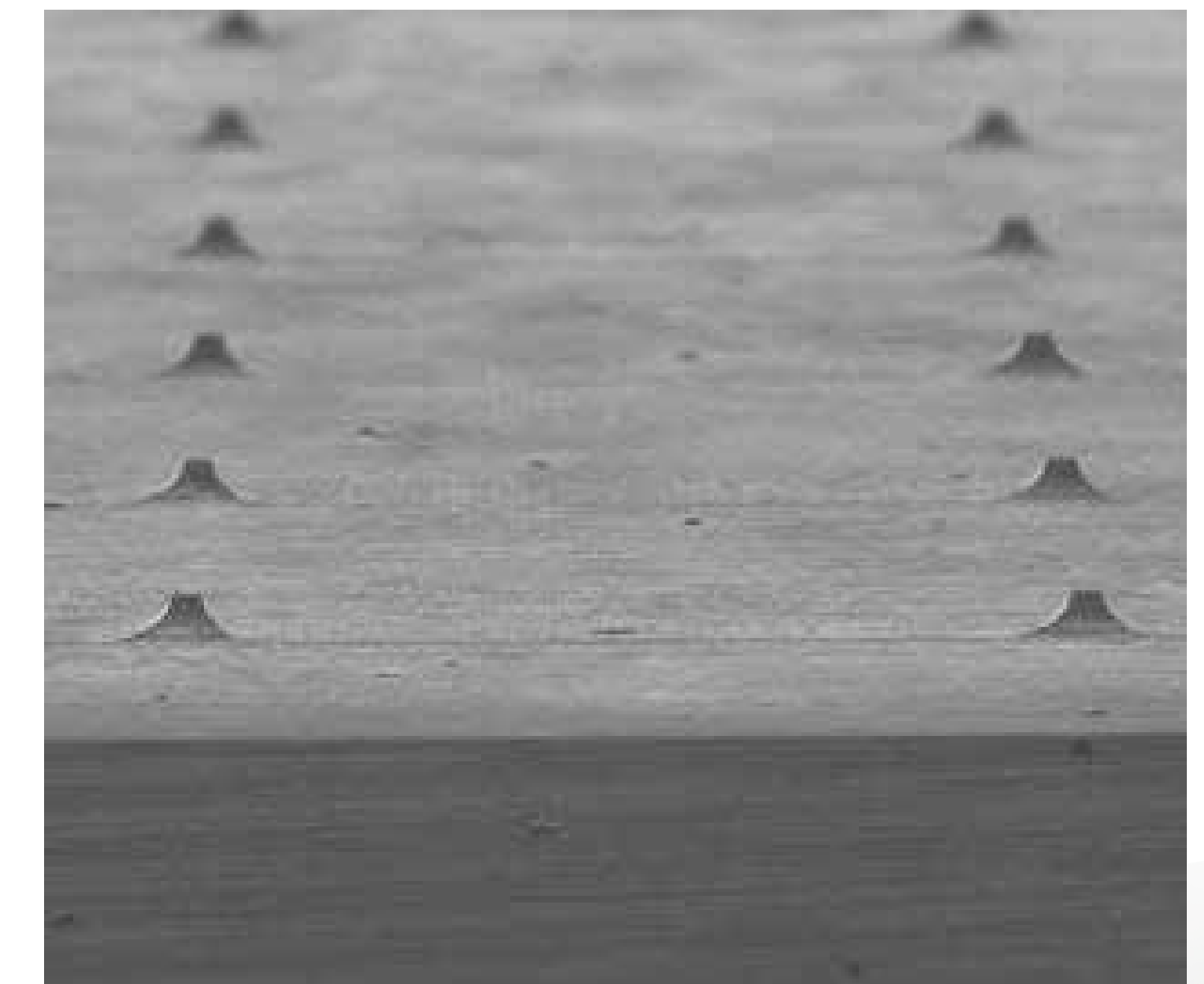
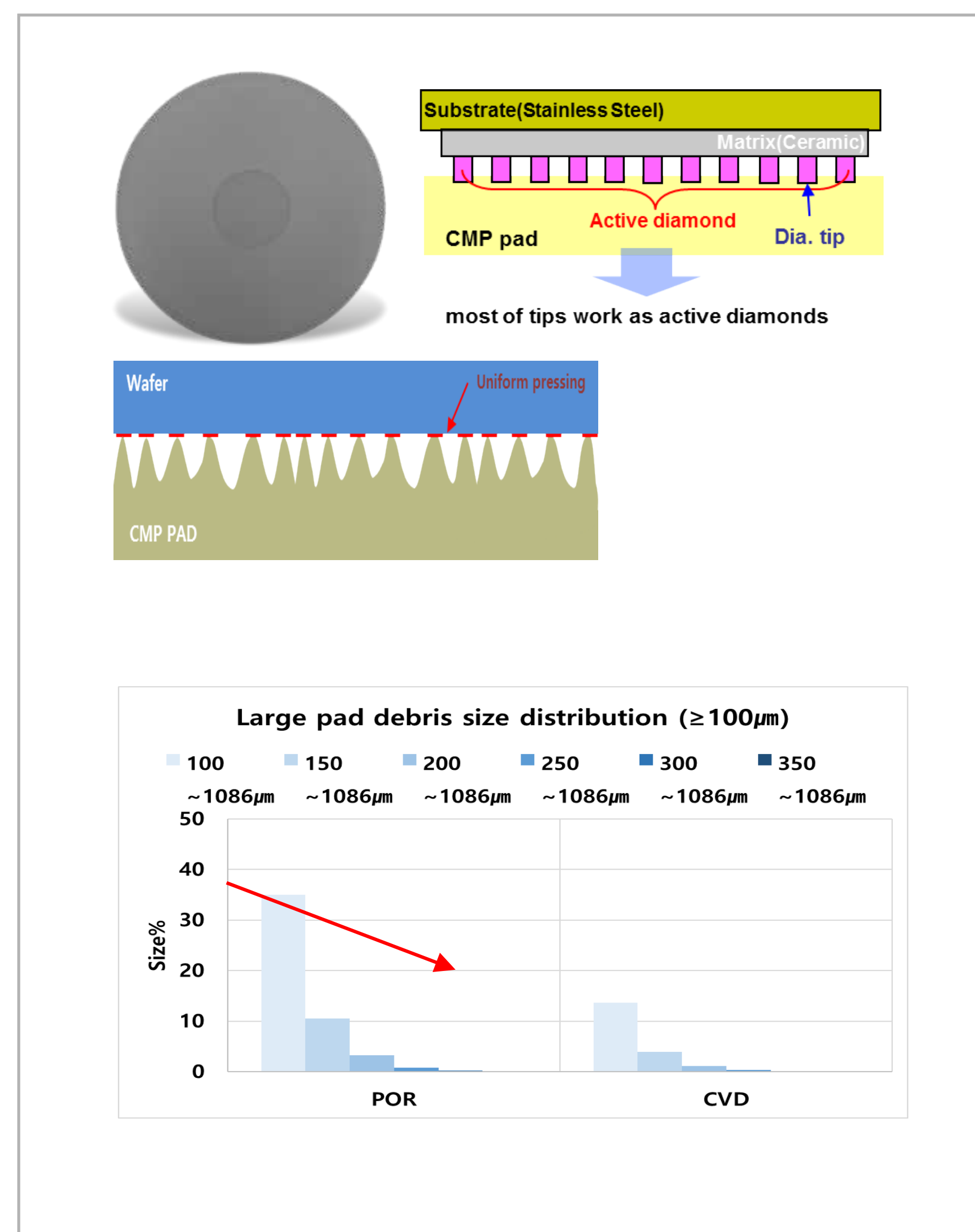
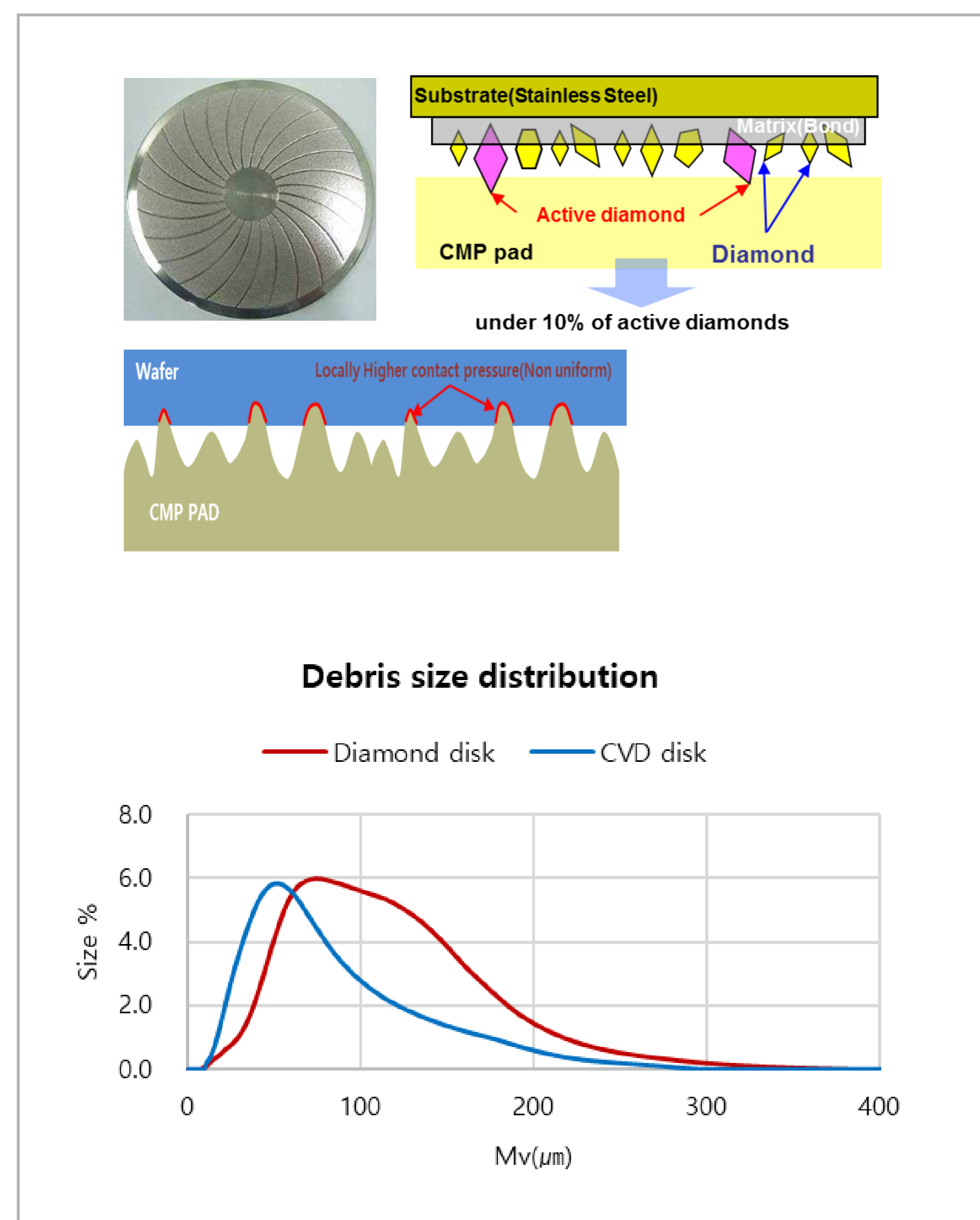
CMP PAD CONDITIONER (CVD)

EHWA CVD CMP Conditioner Technology

* **Technical excellency for defect control by CVD disk**

: Larger pad debris can cause wafer defect.

- 1) Minimum large pad debris due to flat and uniform tip height control.
- 2) Minimum wafer defect and topography from controlled pad debris and lower pad surface roughness.

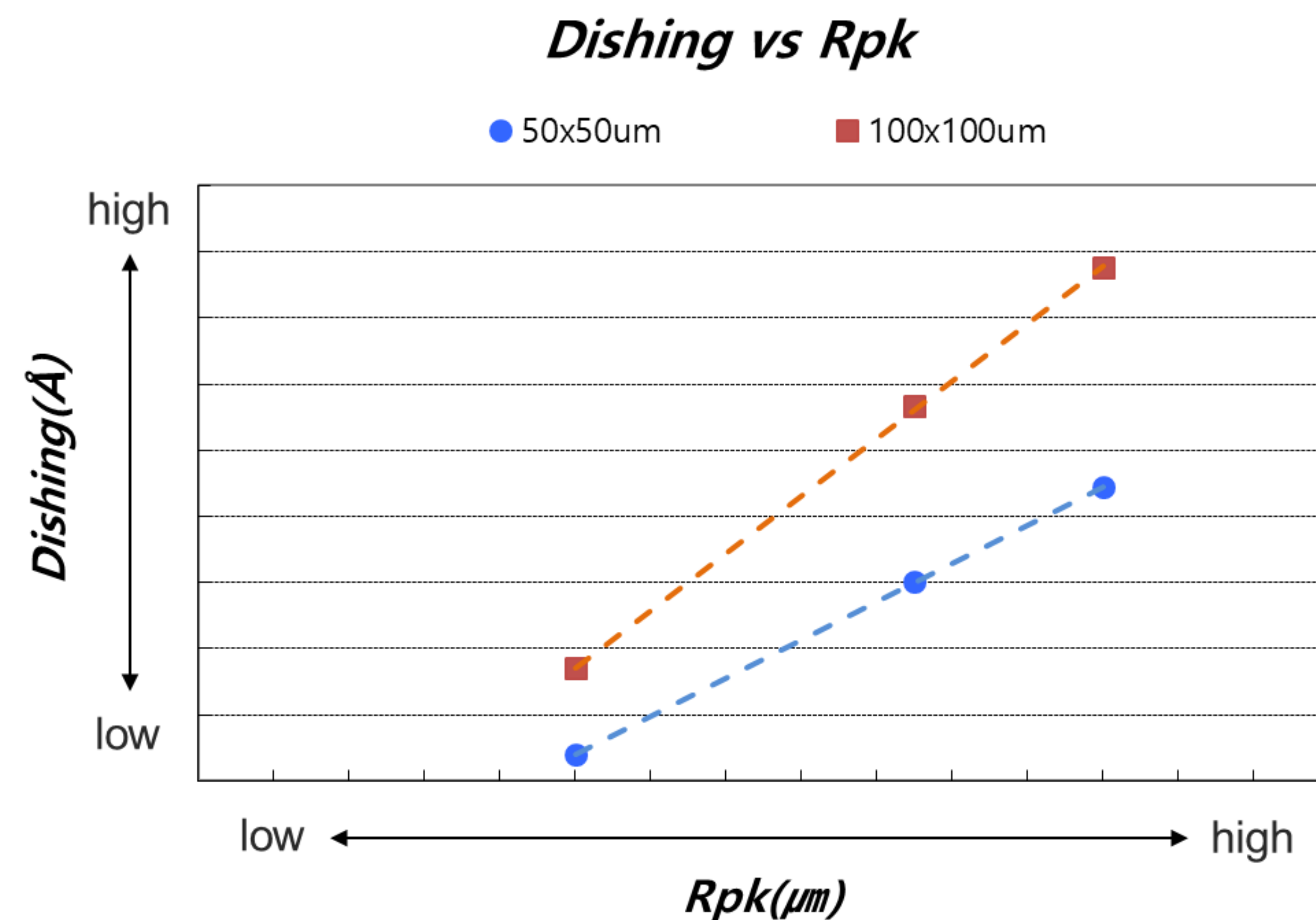


CMP PAD CONDITIONER (CVD)

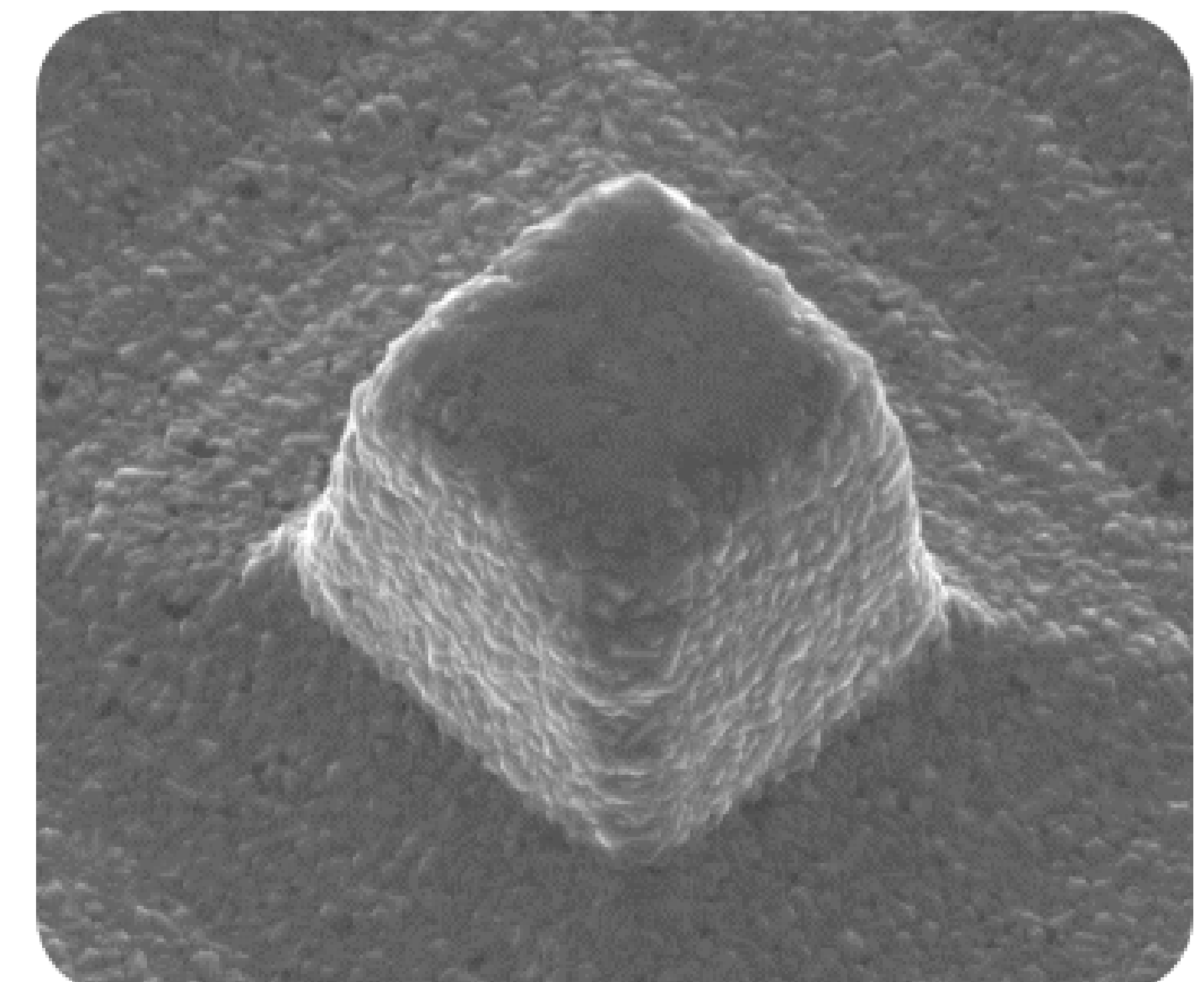
Technical excellency in dishing control by CVD disk

Technical excellency in dishing control by CVD disk

- 1) Excellent diamond tip height uniformity can lead to a smoother and consistent pad surface roughness.
- 2) Lower and consistent pad surface roughness can minimize dishing/erosion over entire pad lifetime.
- 3) Surface roughness can be controlled by customizable diamond tip configuration.



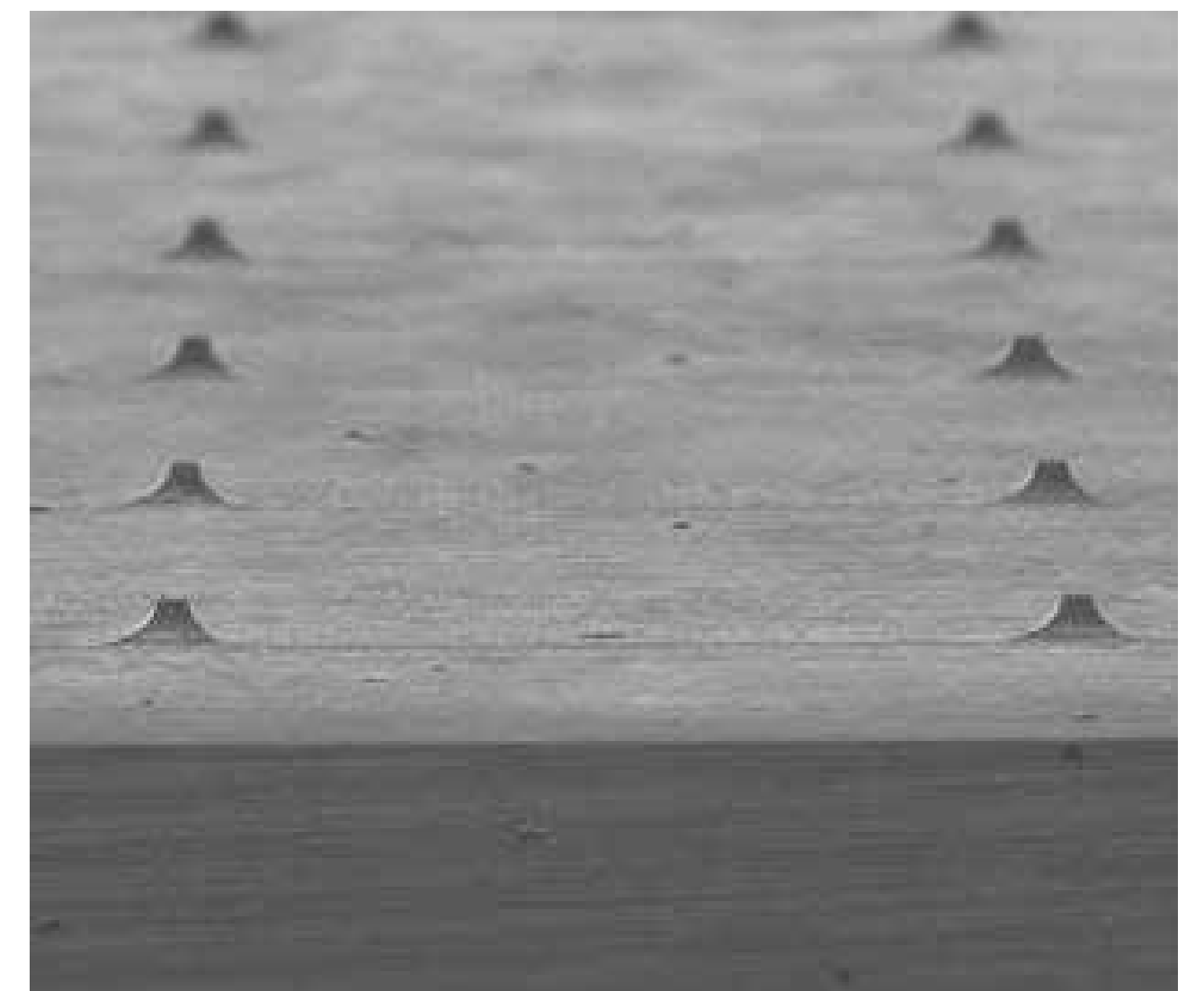
- Polisher : AMAT Reflexion LK
- Wafer : Cu patterned wafer
- Slurry : Cu slurry
- Disk : CVD disk



CMP PAD CONDITIONER (CVD)

EHWA CVD CMP Conditioner Technology

- 'Near-zero' diamond tip height flatness technology to maximize disk lifetime and minimize wafer defect and topography from lower pad surface roughness.
- 'Versatile manipulation' in controlling wide-range of PCR, pad surface roughness, and material removal rate (MRR) powered by customizable diamond tip configuration.
- Lower cost of consumable (CoC) per wafer from single disk / multiple pads enablement from minimum diamond wear.



CMP PAD CONDITIONER (BSL)



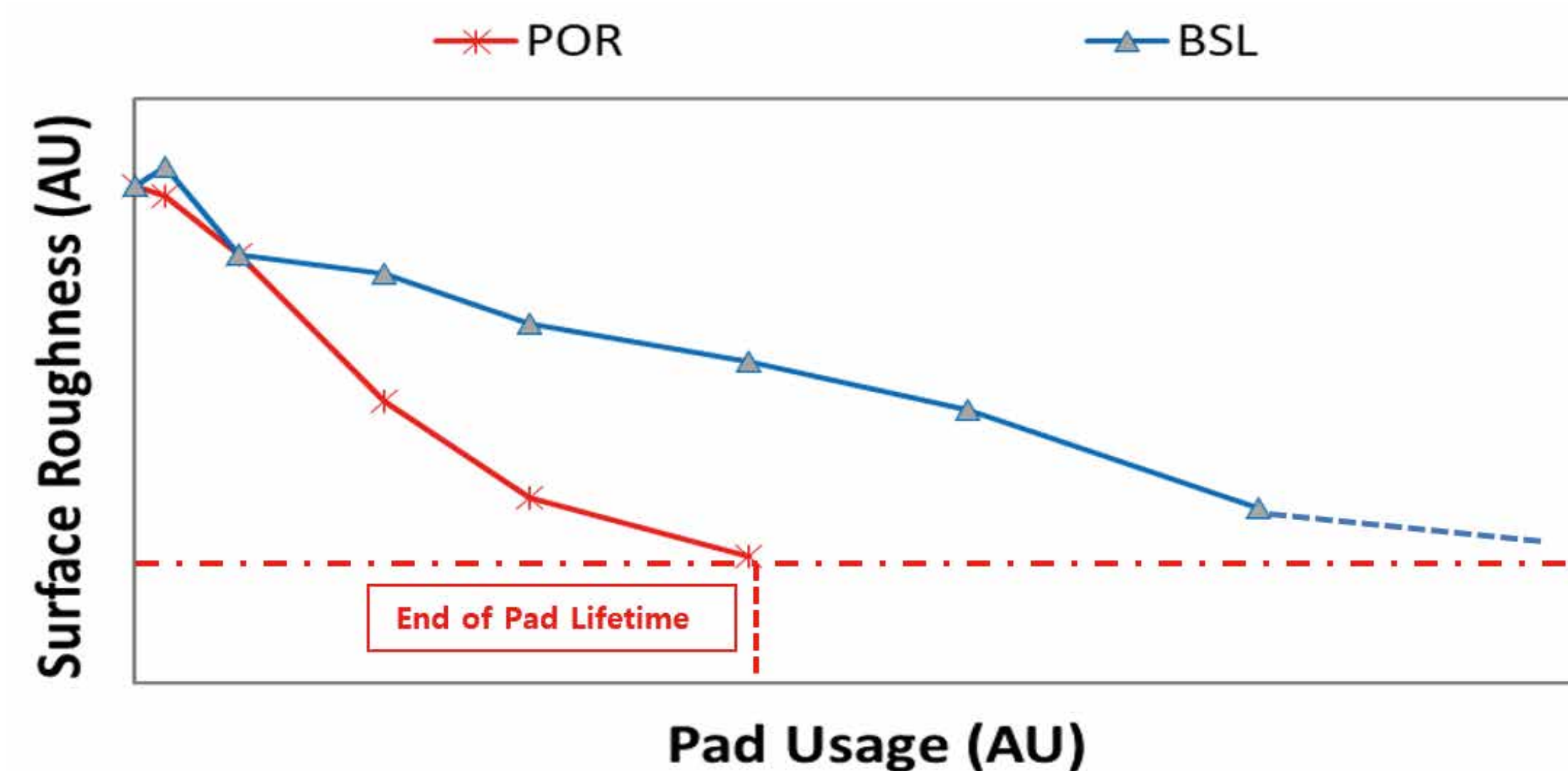
I Advantages

- Strong diamond holding force : Chemical reaction + Mechanical contact
- Corrosion resistance : Carbide interface between diamond & bond material
- Longer lifetime : Utilization of edges by diamond face
- Maximized diamond chip pocket by high diamond exposure
→ Excellent conditioning efficiency and pad debris removal rate

I Pad Surface Roughness with Pad Lifetime

Technical excellency in maintaining pad cut rate and surface roughness by BSL disk

- 1) High and 'long-lasting' pad cut rate (PCR) and surface roughness is powered by EHWA Diamond proprietary brazing and diamond orientation control technology
- 2) Long-lasting BSL disk can enable longer pad lifetime and support lower CoC due to higher CMP tool uptime and less pad change.

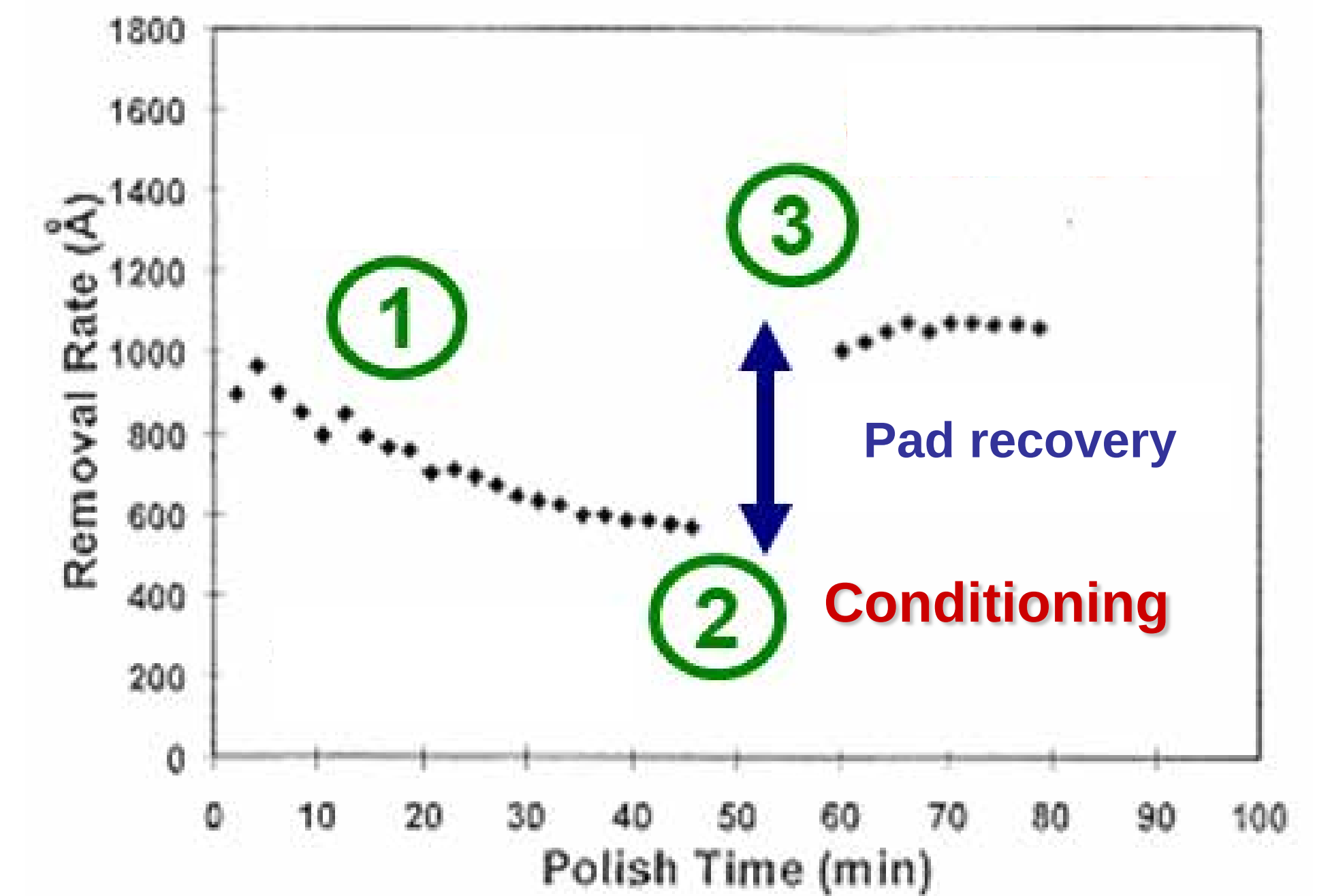
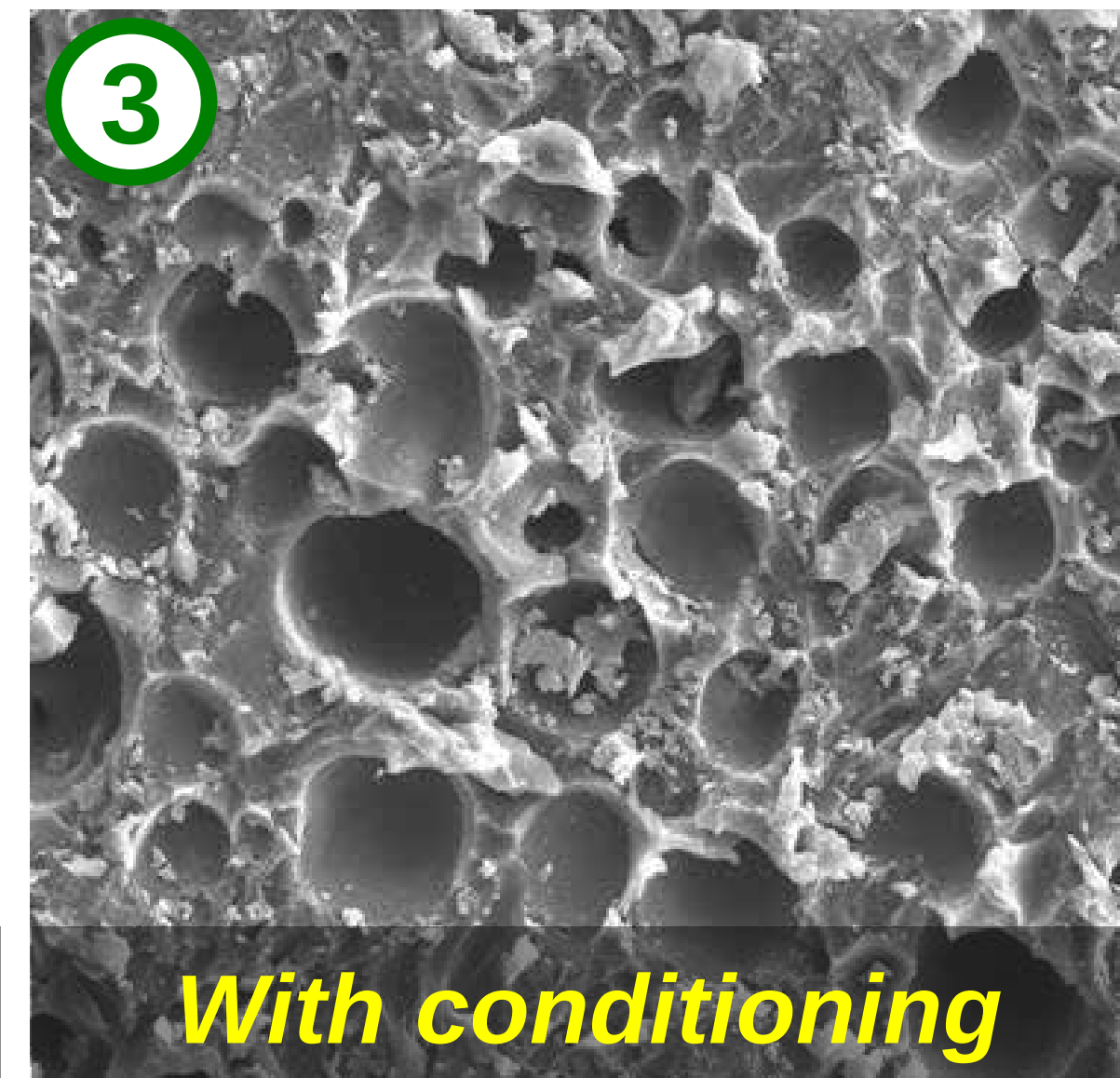
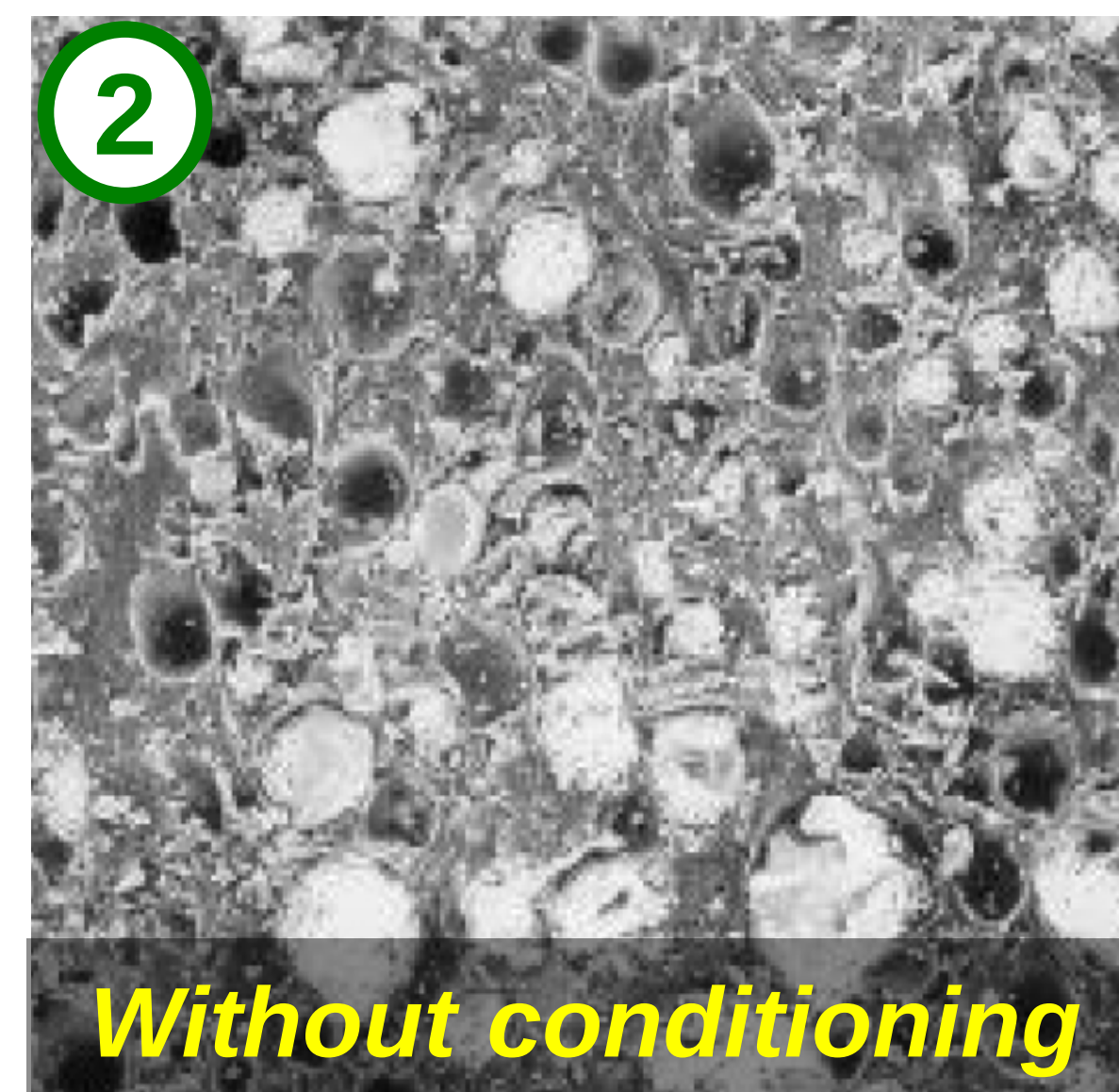
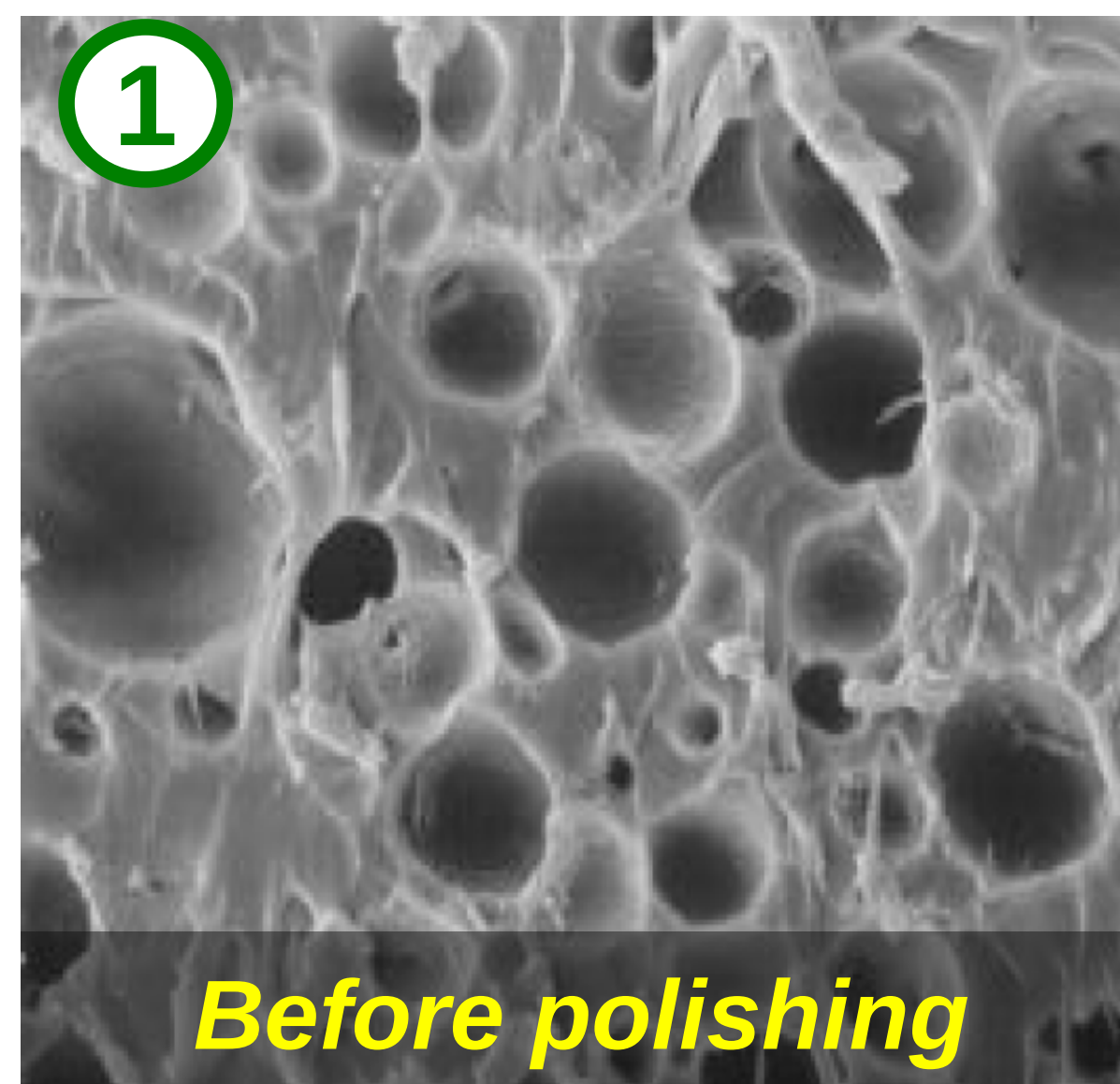


CMP PAD CONDITIONER (BSL)

Role of CMP Pad Conditioner

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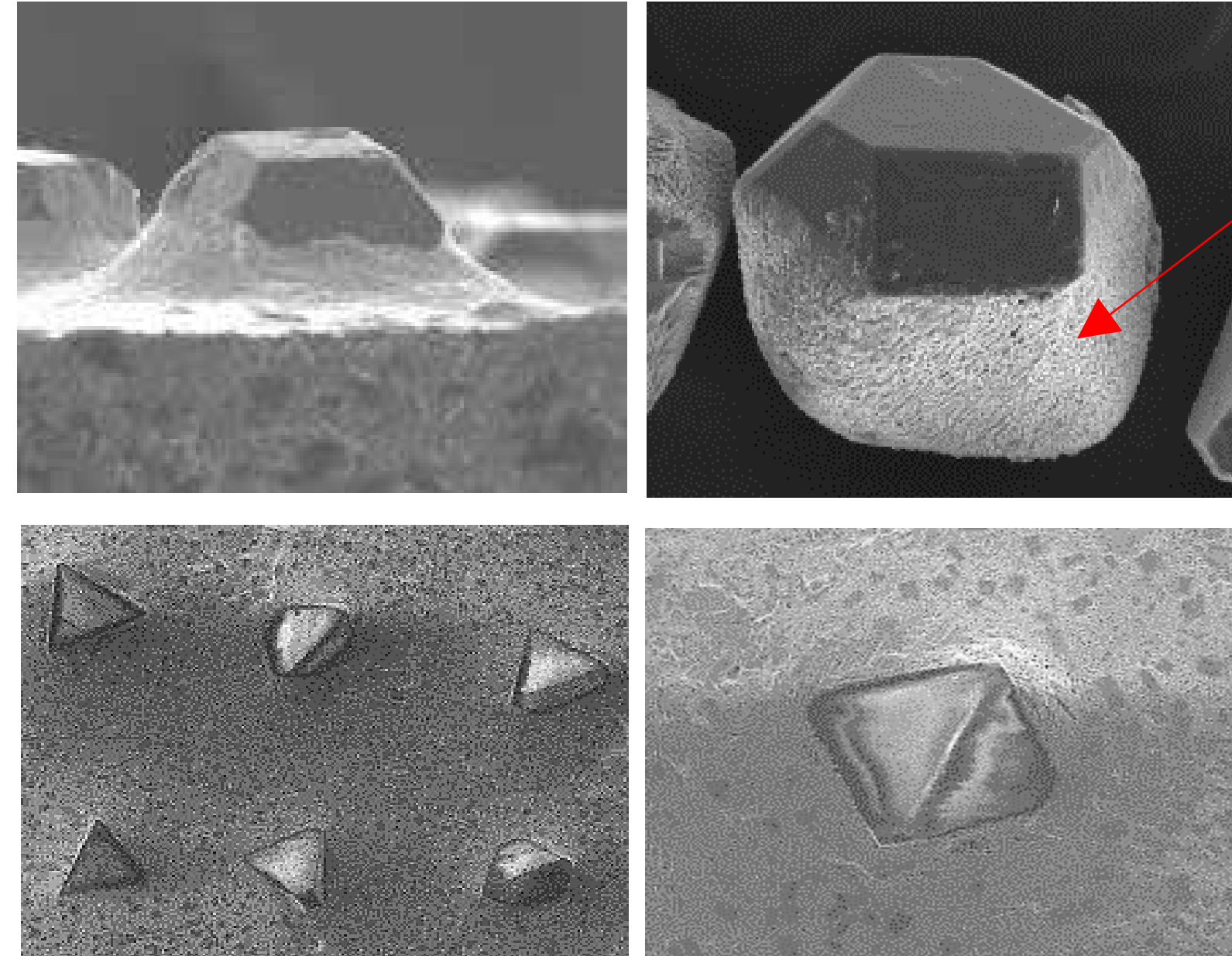
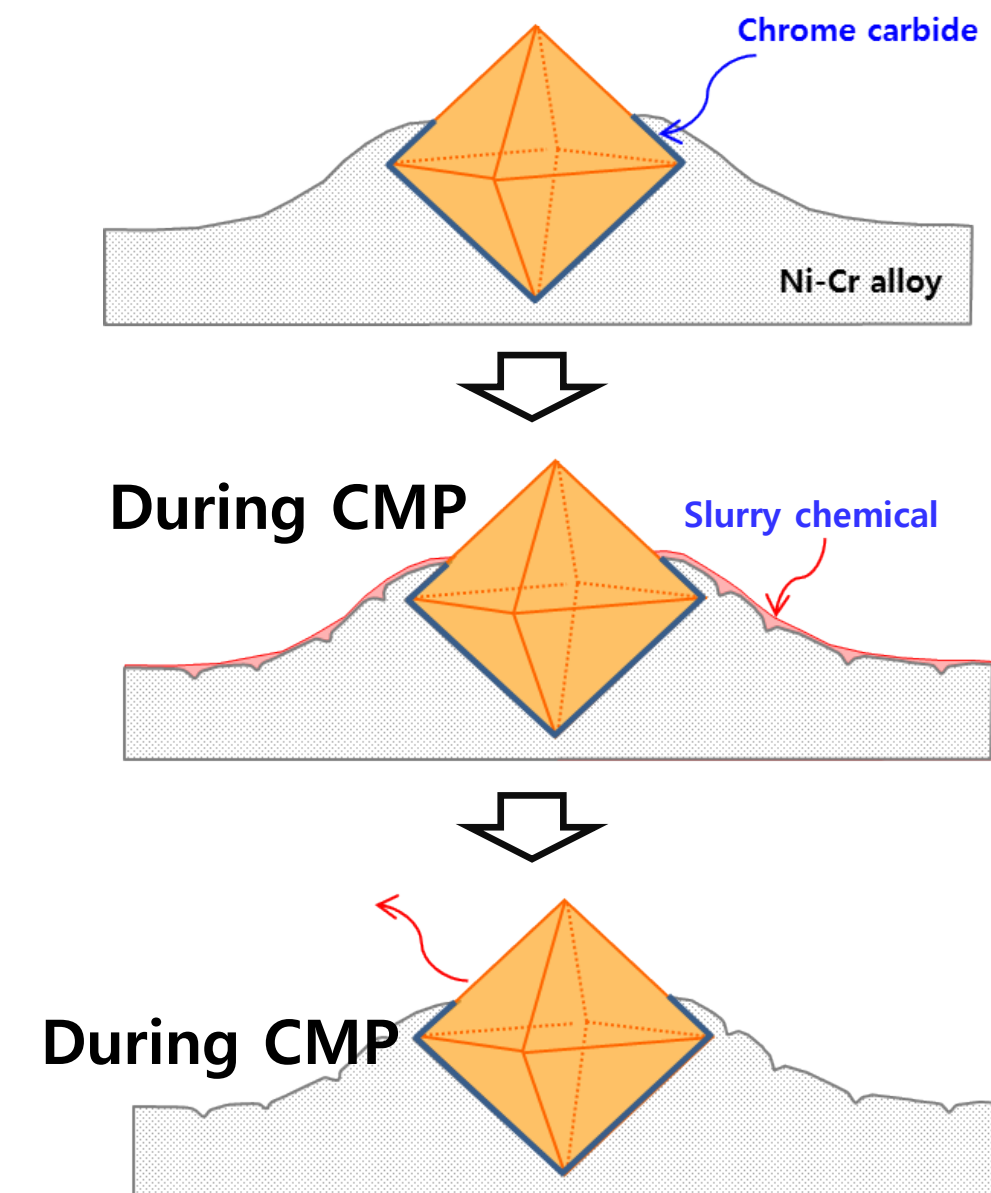


- Prevent pad glazing during CMP
- Guarantee defect/topography control
- Maintain high material removal rate
- Sustain good wafer uniformity

- Pad lifetime extension
 - CMP process optimization
 - Yield improvement
- Best CMP Process!***

CMP PAD CONDITIONER (BSL)

(BSL diamond disk)



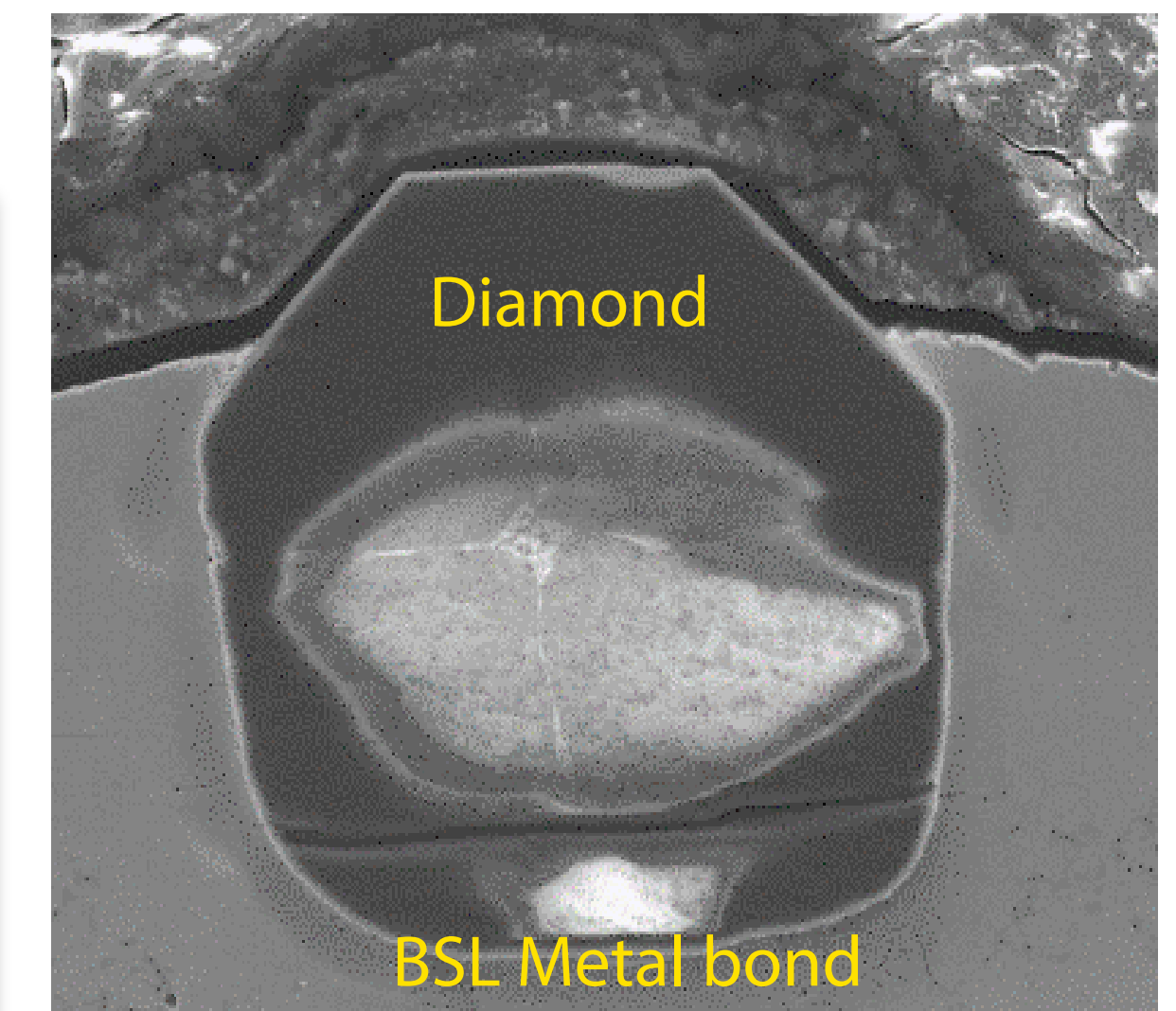
EHWA BSL disk after 60h usage

Chrome Carbide by
chemical reaction between
diamond and metal matrix

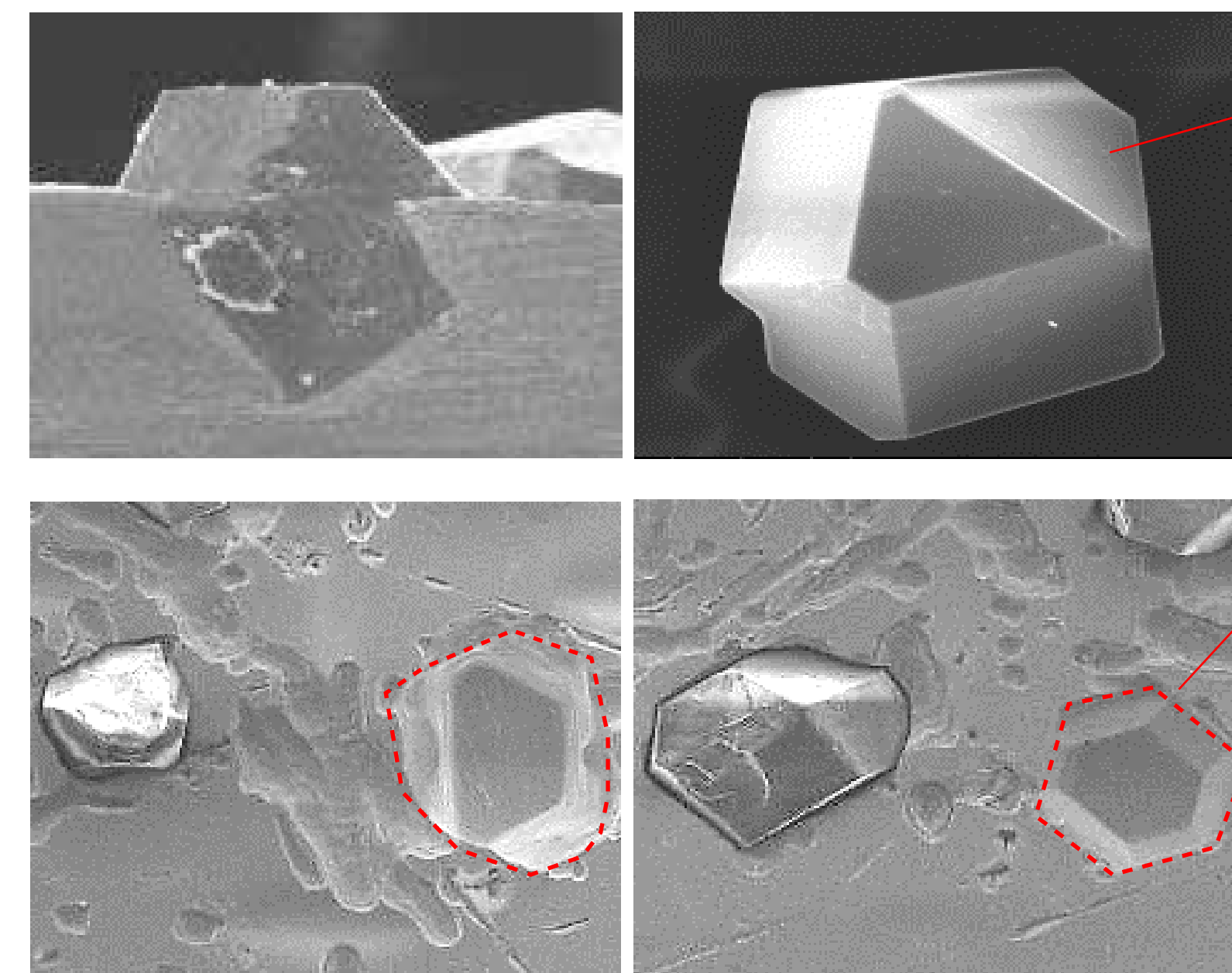
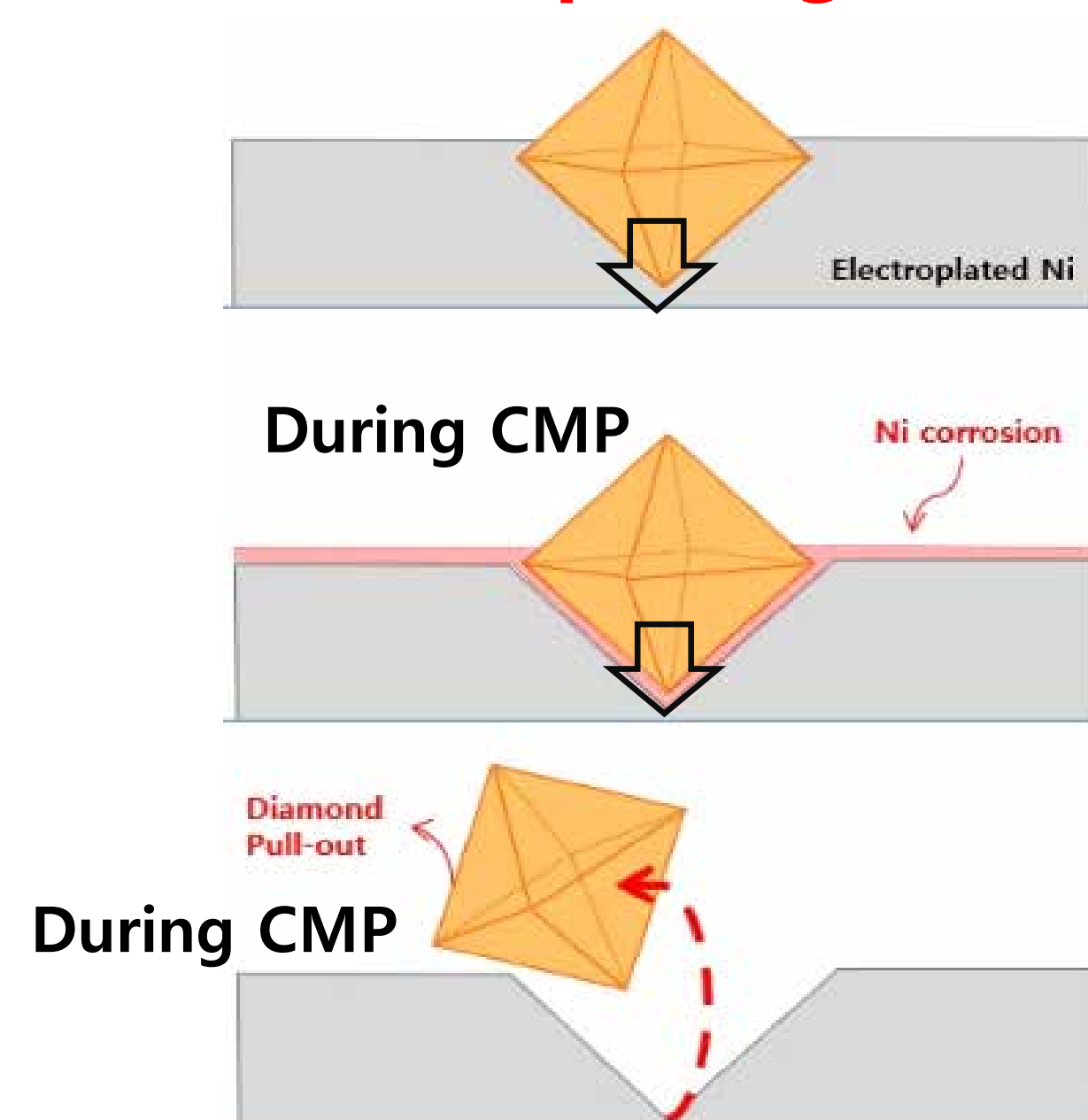
No
diamond
loss observed

Surface buried in metal
bond layer
(Chemical+Mechanical
bonding with diamond)->
Strongest bonding
between diamond and
metal matrix

BSL Disk



(Electroplating disk)



Electroplating disk after 20h usage

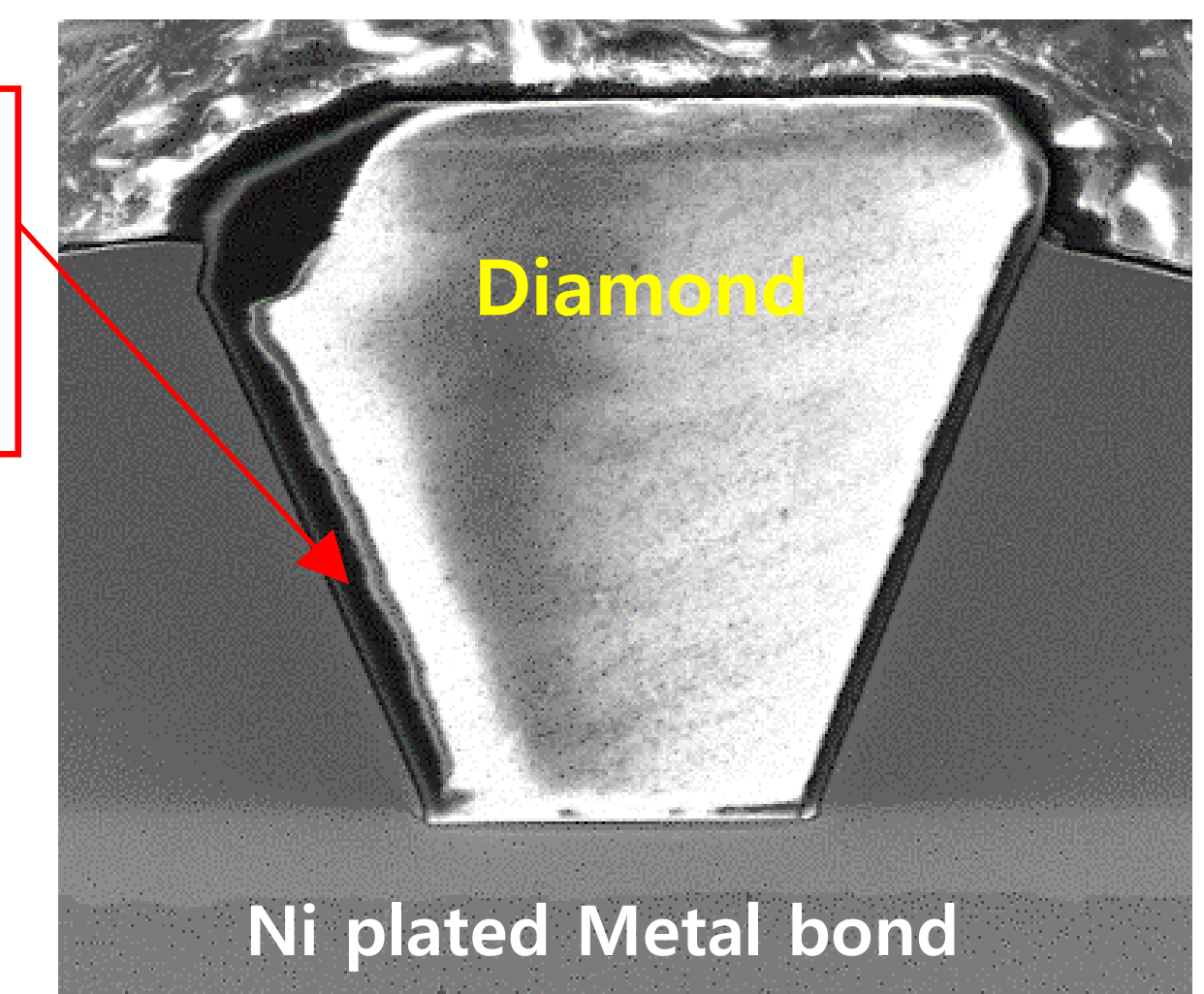
Surface buried in Ni bond
layer (Mechanical holding only)

Heavy diamond loss
observed

Interface gap->
Weaker bonding
than BSL

Surface buried in metal bond layer
(No Chemical bonding with diamond)
-> Weak bonding between diamond

Electroplating Disk

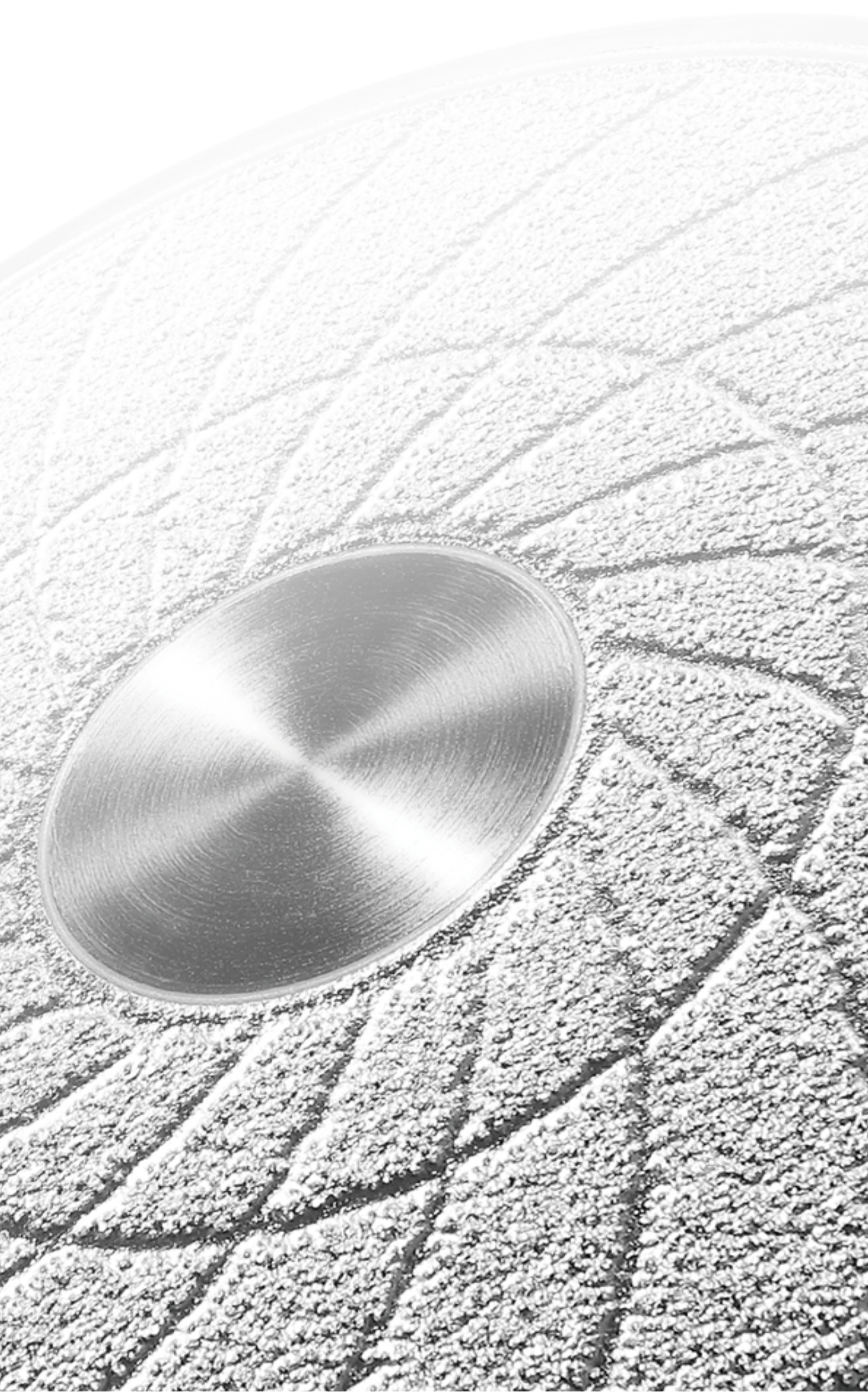
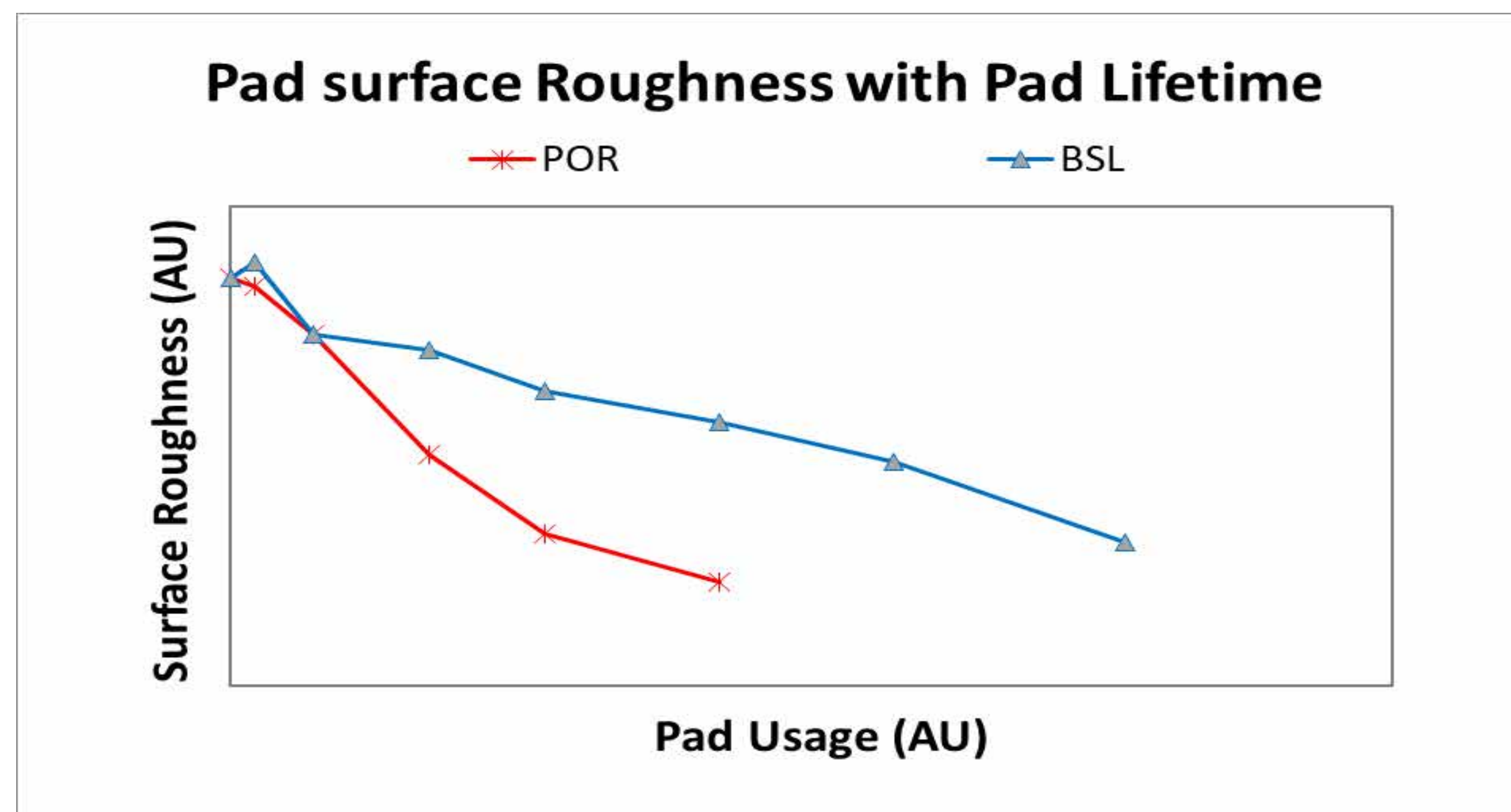


CMP PAD CONDITIONER (BSL)

EHWA BSL CMP Conditioner Technology

Technical excellency in maintaining pad cut rate and surface roughness by BSL disk

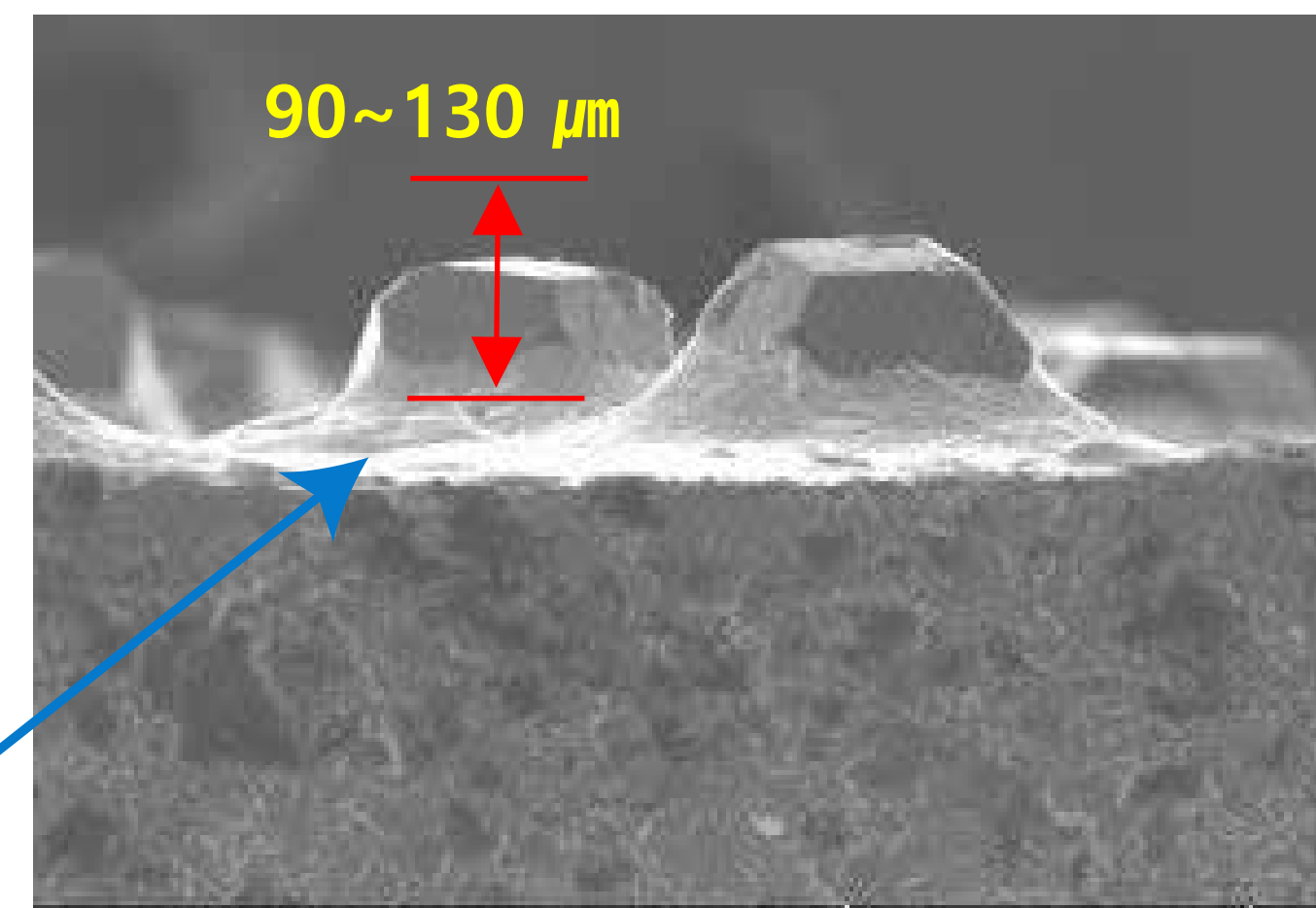
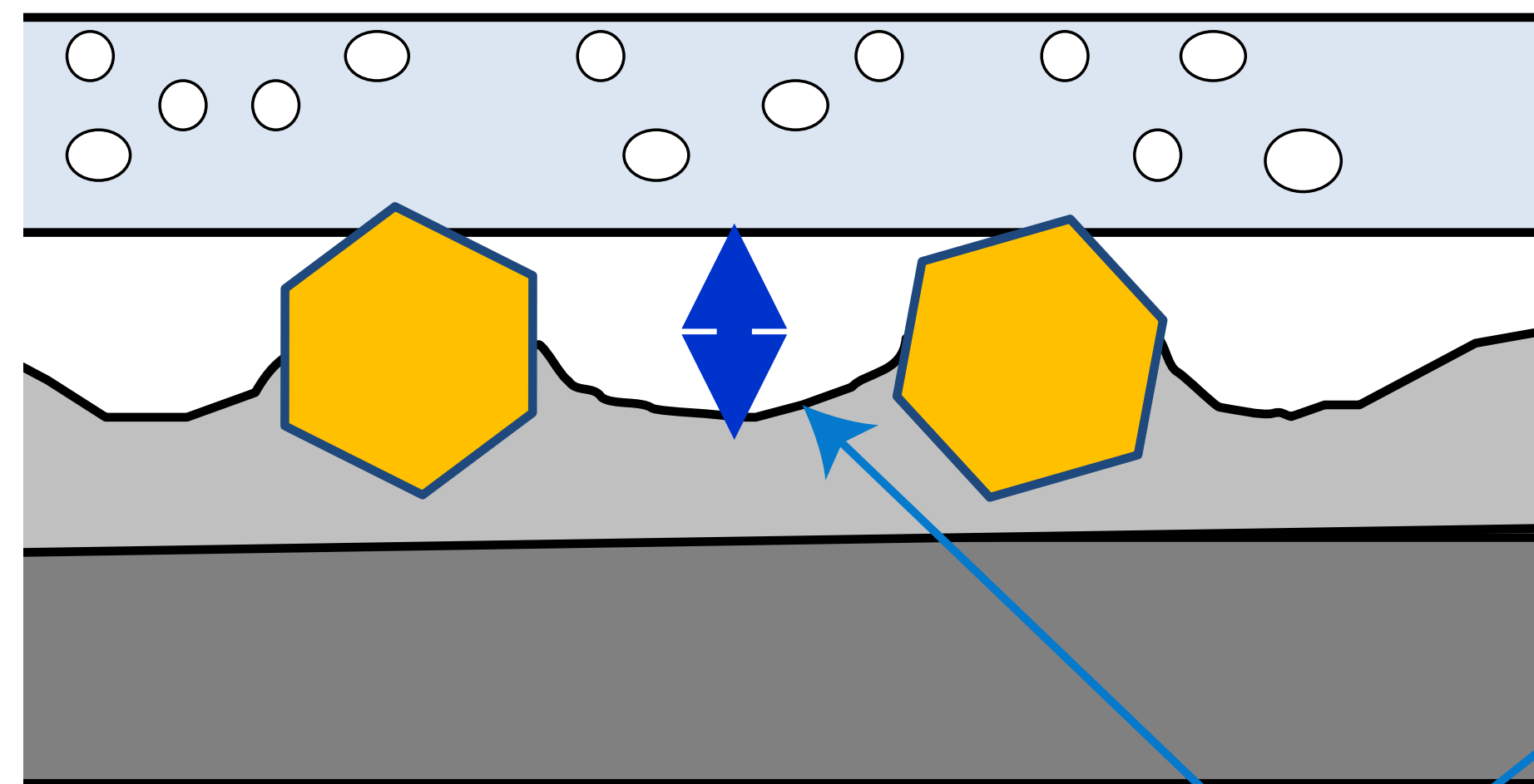
- 1) High and 'long-lasting' pad cut rate (PCR) and surface roughness is powered by EHWA Diamond proprietary brazing and diamond orientation control technology.
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CMP PAD CONDITIONER (BSL)

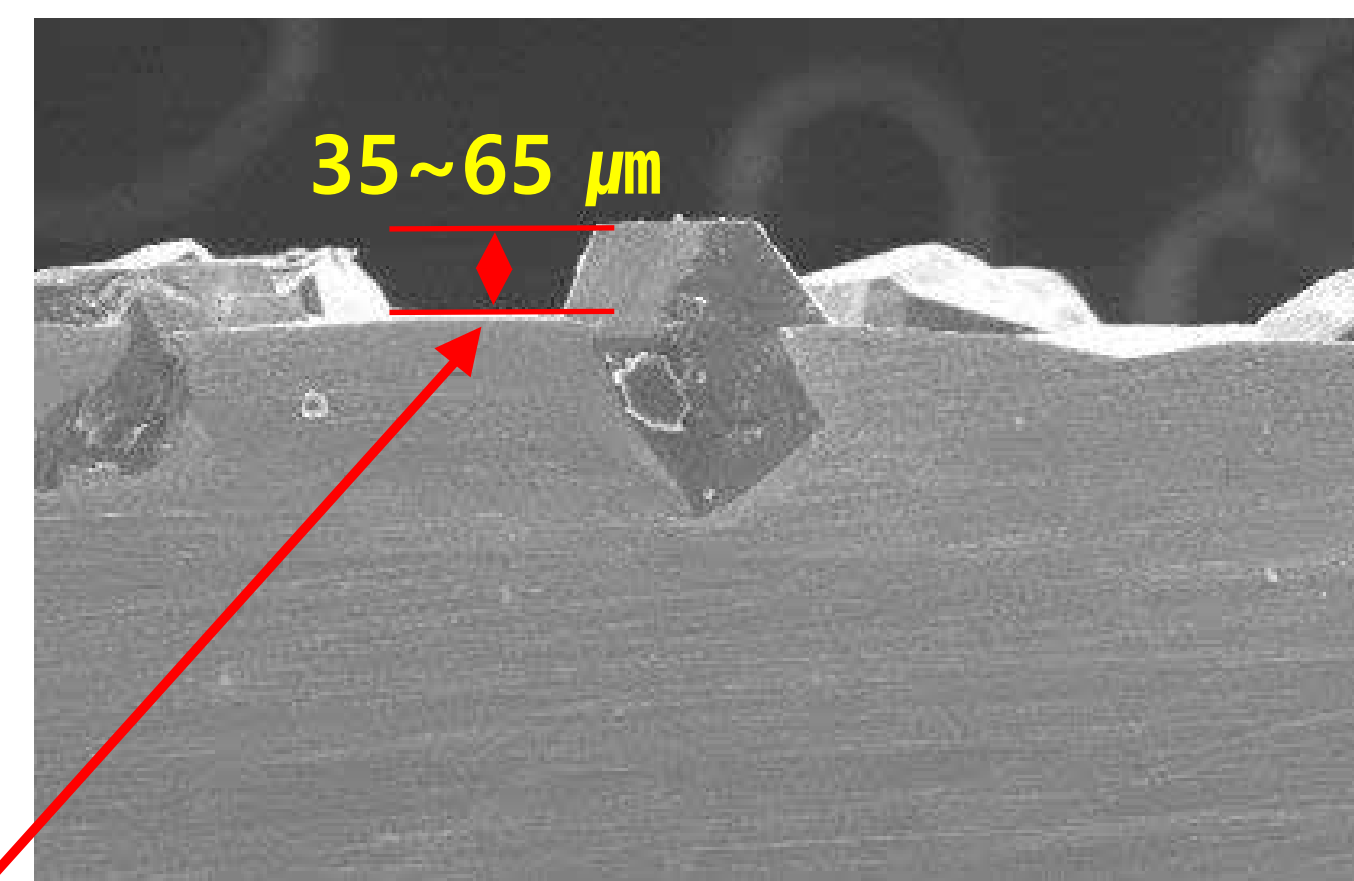
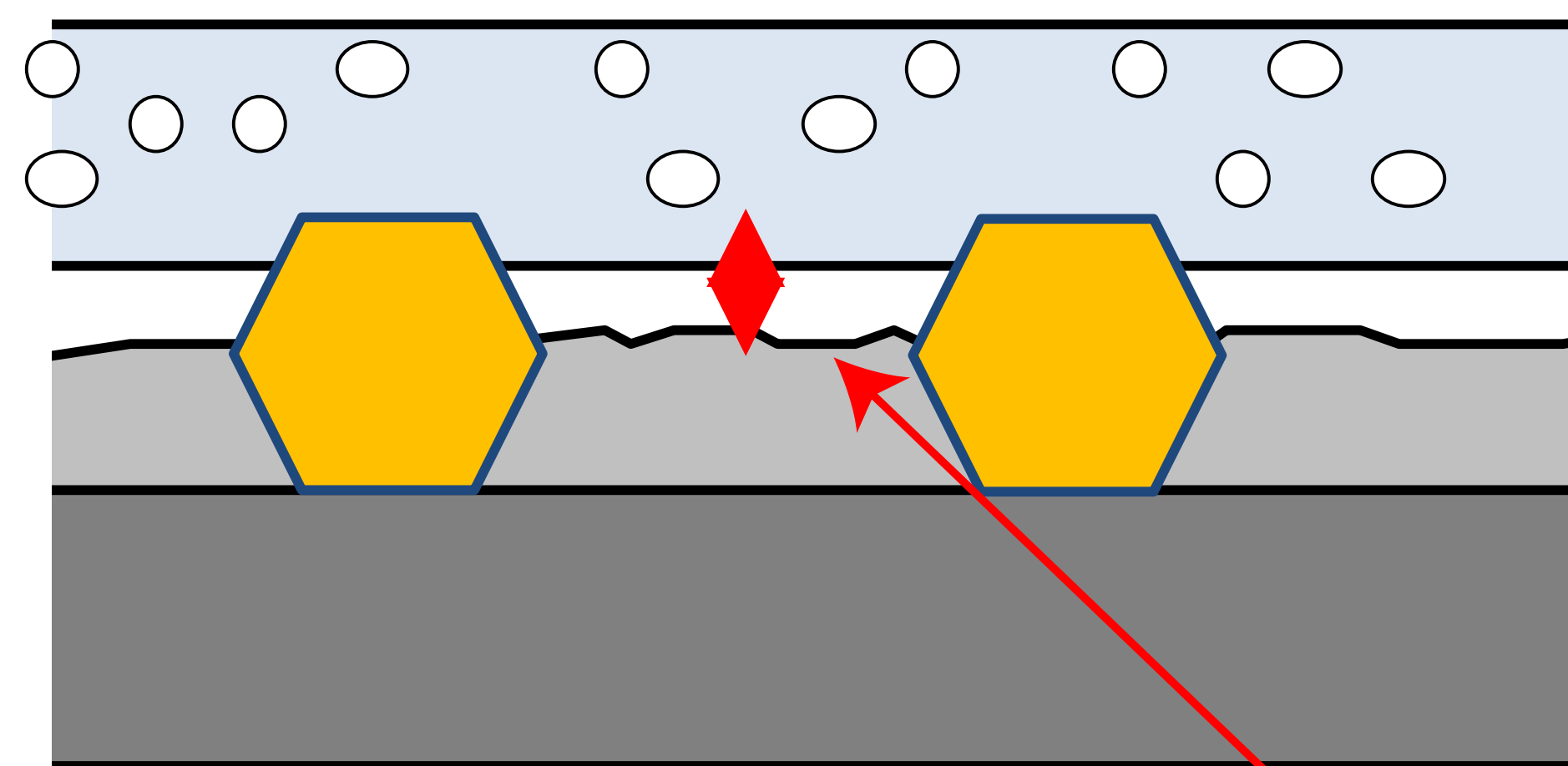
EHWA BSL CMP Conditioner Technology

Brazing(BSL) Disk

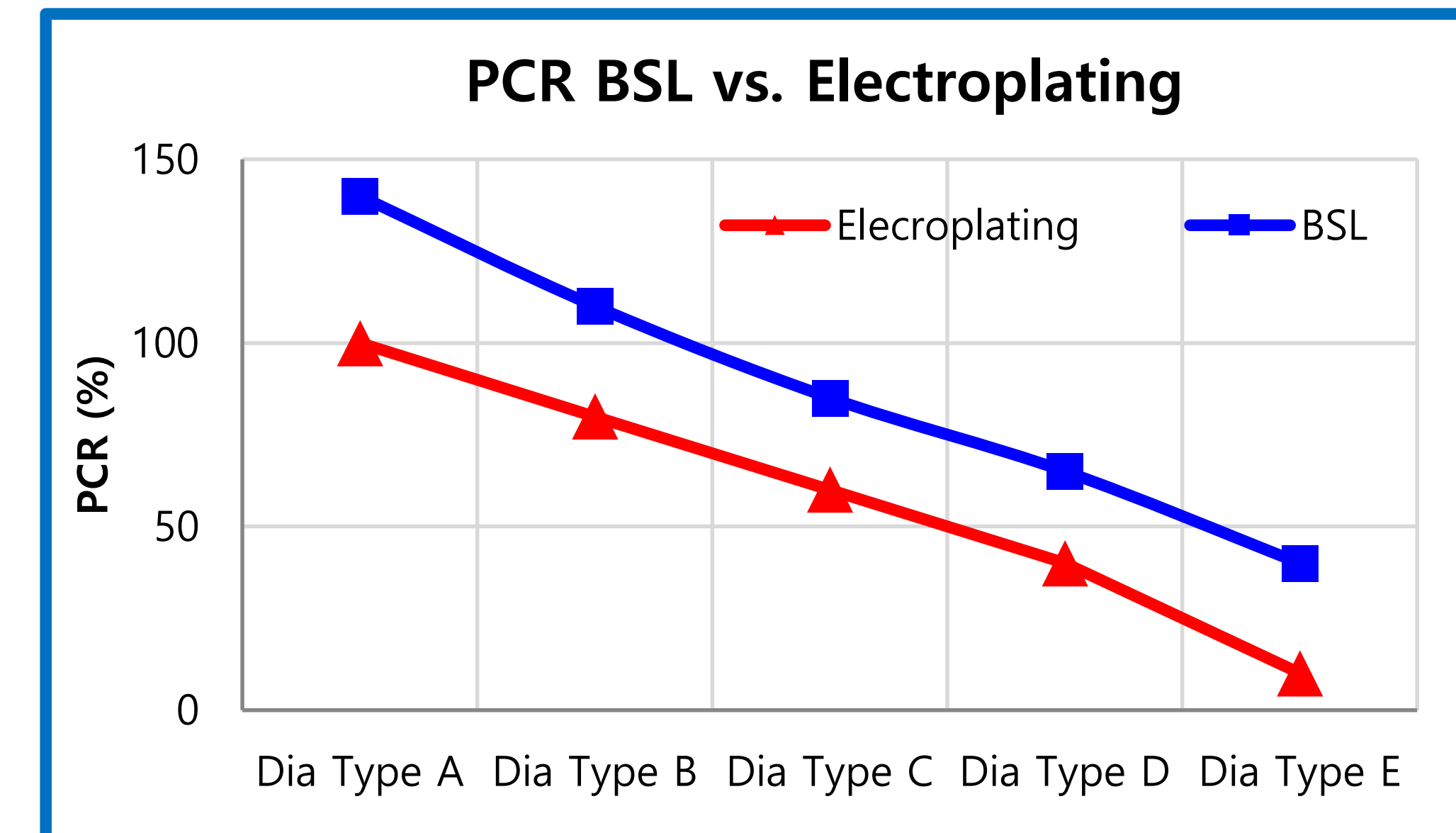


Metal matrix 'climb-up' only around the diamond surface due to BSL process → Higher diamond exposure → Higher PCR

Electroplating Disk



Metal matrix must deposit over the diamond to provide enough bonding → Lower diamond exposure → Lower PCR

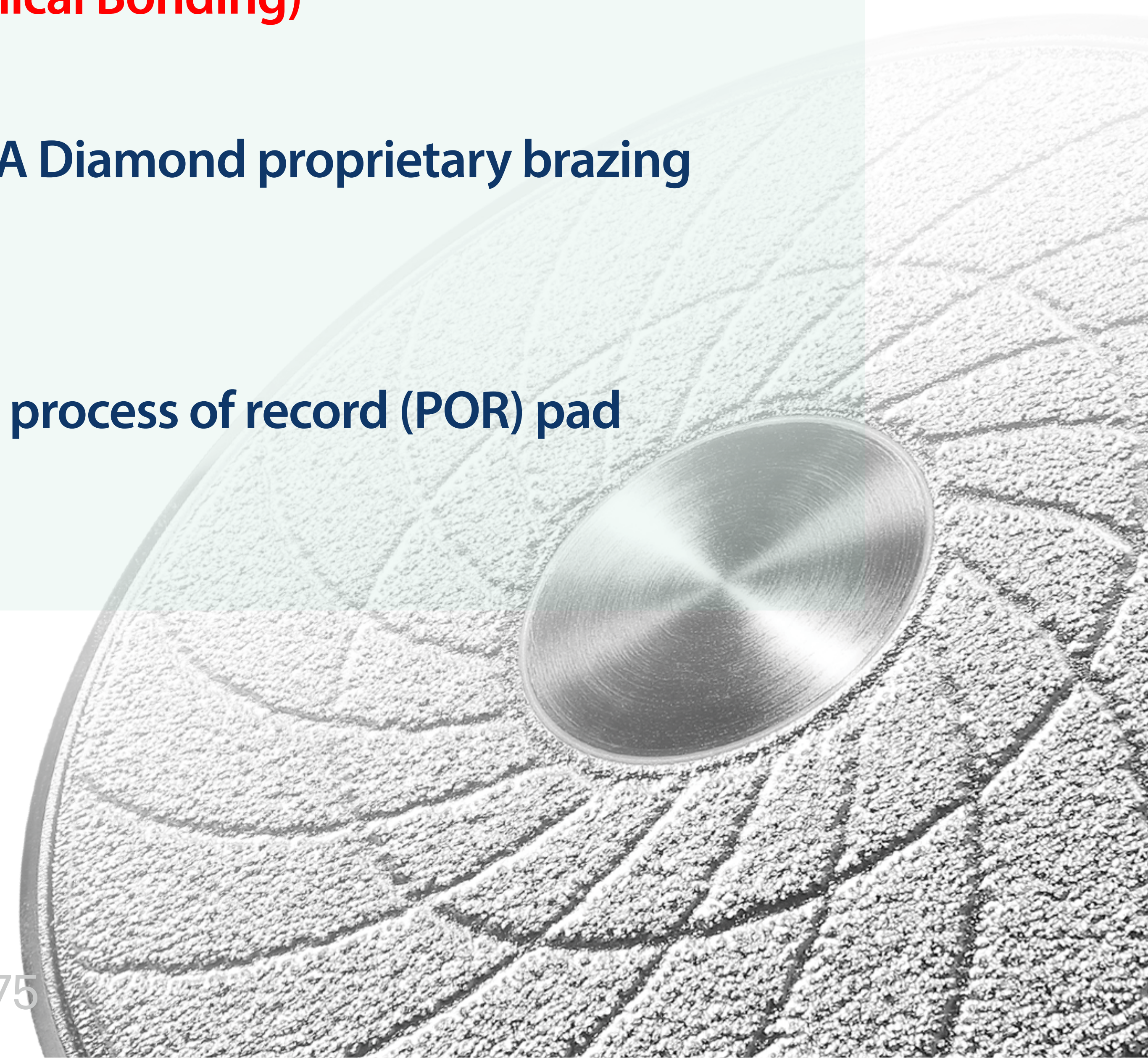


From diamond disk technology point of view, the diamond exposure is higher for BSL disk which causes higher pad cut rate and material removal rate at CMP process.

CMP PAD CONDITIONER (BSL)

EHWA BSL CMP Conditioner Technology

- Proprietary brazing powder and high temperature/vacuum brazing process for the strongest diamond bonding capability in the global CMP conditioning disk market.
→ **Powered by dual bonding mode (Mechanical+Chemical Bonding)**
- High and 'long-lasting' pad cut rate (PCR) enabled by EHWA Diamond proprietary brazing and diamond orientation control technology.
- Enabling technology for high MRR in SiC CMP process as a process of record (POR) pad conditioner in the CMP market.



CMP PAD CONDITIONER (RING & PELLETS)

I EHWA BSL CMP Conditioner Technology for Large Size Disk

EHWA BSL and CVD diamond disk technology is available for any large size CMP disks which include bar-type disks, ring-type disks, or any disks needed for legacy CMP tools.

- Proprietary brazing powder and high temperature/vacuum brazing process for the strongest diamond bonding capability in the global CMP conditioning disk market.
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EHWA DIAMOND | SINCE 1975

CMP PAD CONDITIONER (RING & PELLETS)

CMP PAD CONDITIONER

- Strong diamond holding force: Chemical reaction + Mechanical contact
- Corrosion resistance: Carbide interface between diamond & bond material
- Longer lifetime: Utilization of edges by diamond face
- Maximized diamond chip pocket by high diamond exposure
- Excellent conditioning efficiency and pad debris removal rate



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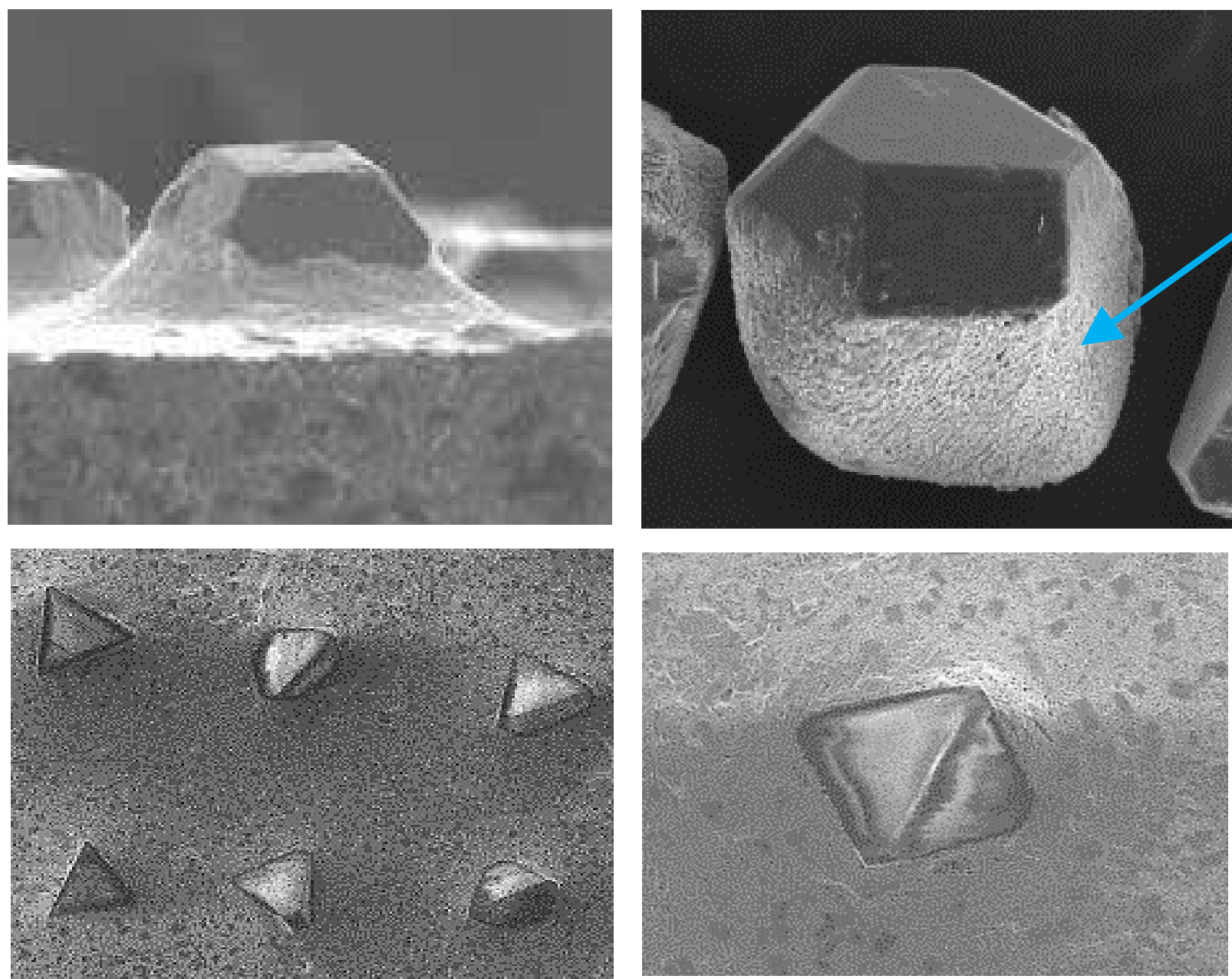
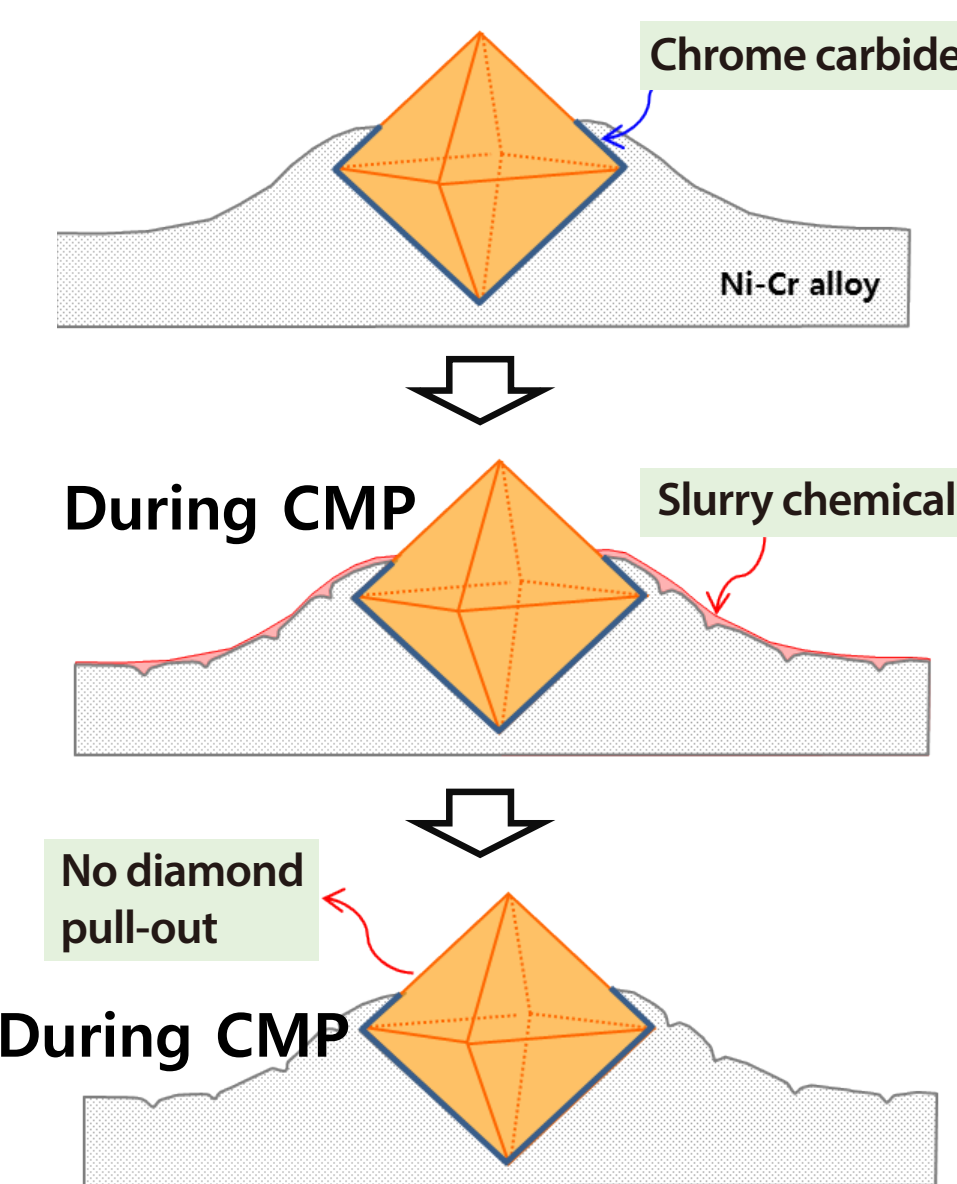


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CMP PAD CONDITIONER (RING & PELLETS)



(BSL diamond disk)



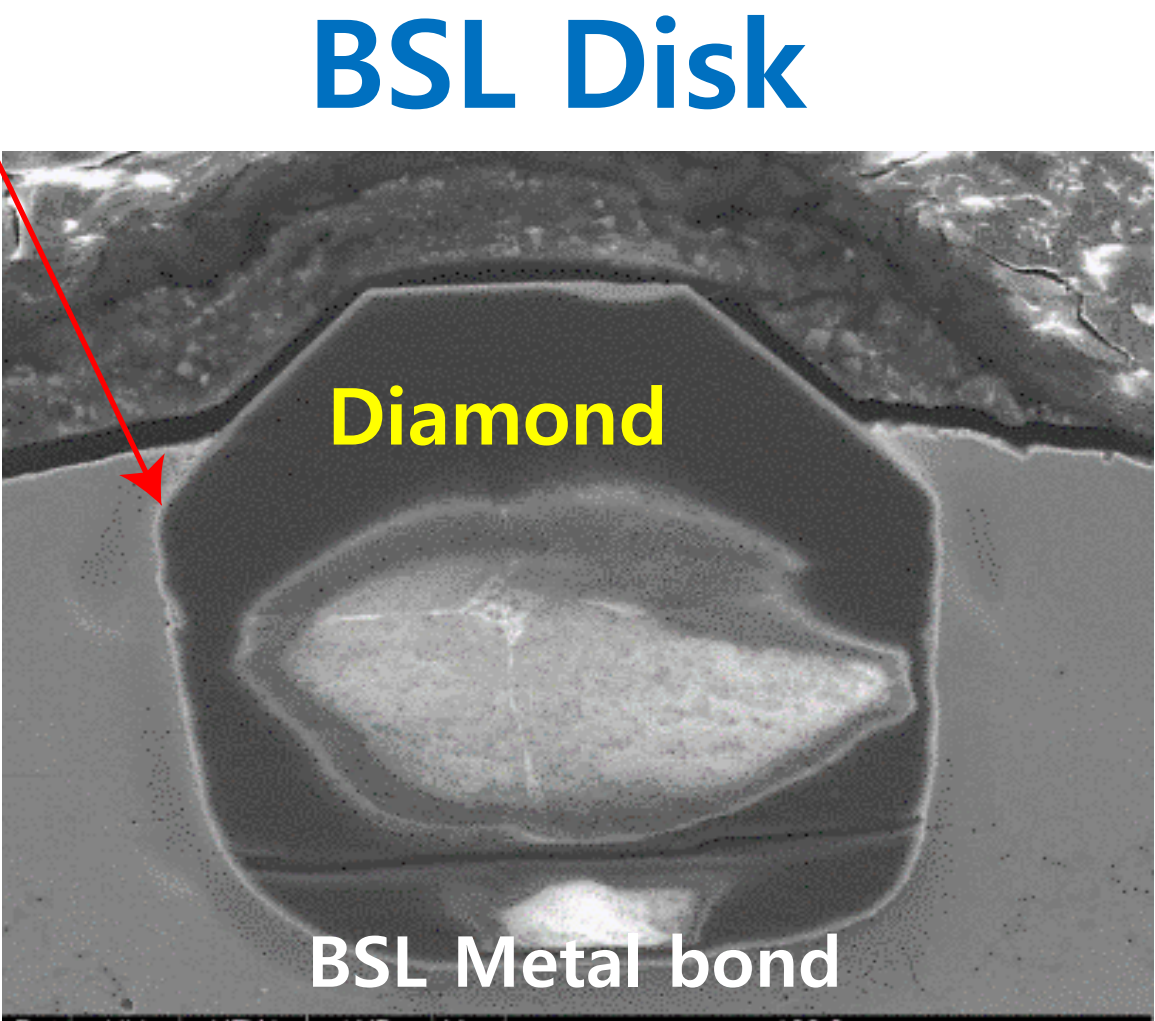
EHWA BSL disk after 60h usage

Chrome Carbide by chemical reaction between diamond and metal matrix

No diamond loss observed

Surface buried in metal bond layer (Chemical+Mechanical bonding with diamond)-> Strongest bonding between diamond and metal matrix

No gap! → Strong bonding



CMP PAD CONDITIONER (RING & PELLETS)

- Proprietary brazing powder and high temperature/vacuum brazing process for the strongest diamond bonding capability in the global CMP conditioning disk market.
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