End-Point Detection in CMP

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Berkeley, CA

2001 GOAL: Build integrated CMP model for basic mechanical and chemical elements. Develop periodic grating metrology by 9/30/2001

Motivation

In-line monitoring and automatic endpoint of CMP offers many manufacturing advantages

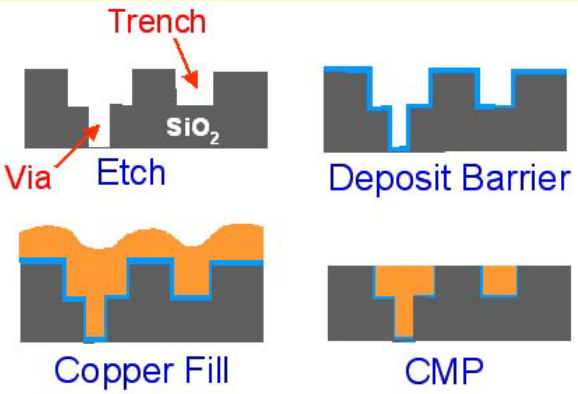
- *Improved Process Yields*
- *Reduced Product Variability*
- *Closer Conformance to Target Requirements*
- *Higher Throughput*

But, difficult to implement due to the nature of the CMP process

Where EPD is needed

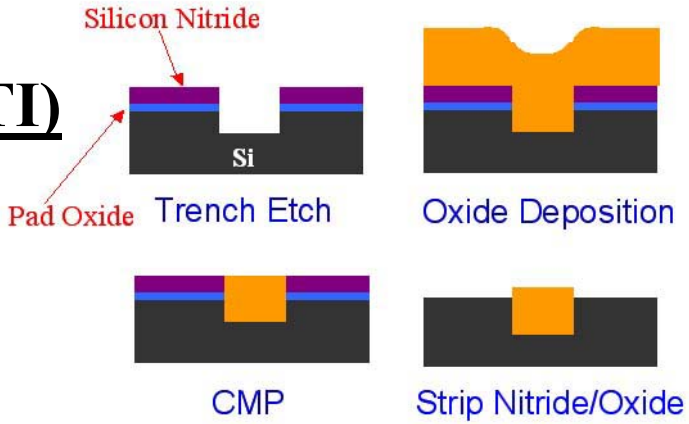
Cu Damascene

Cu / Ta(or TaN) / Oxide



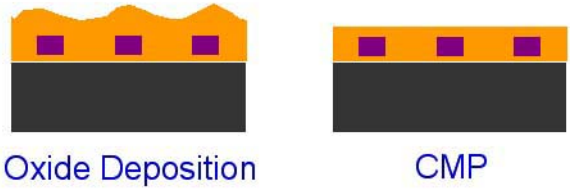
Shallow Trench Isolation (STI)

Oxide/Nitride

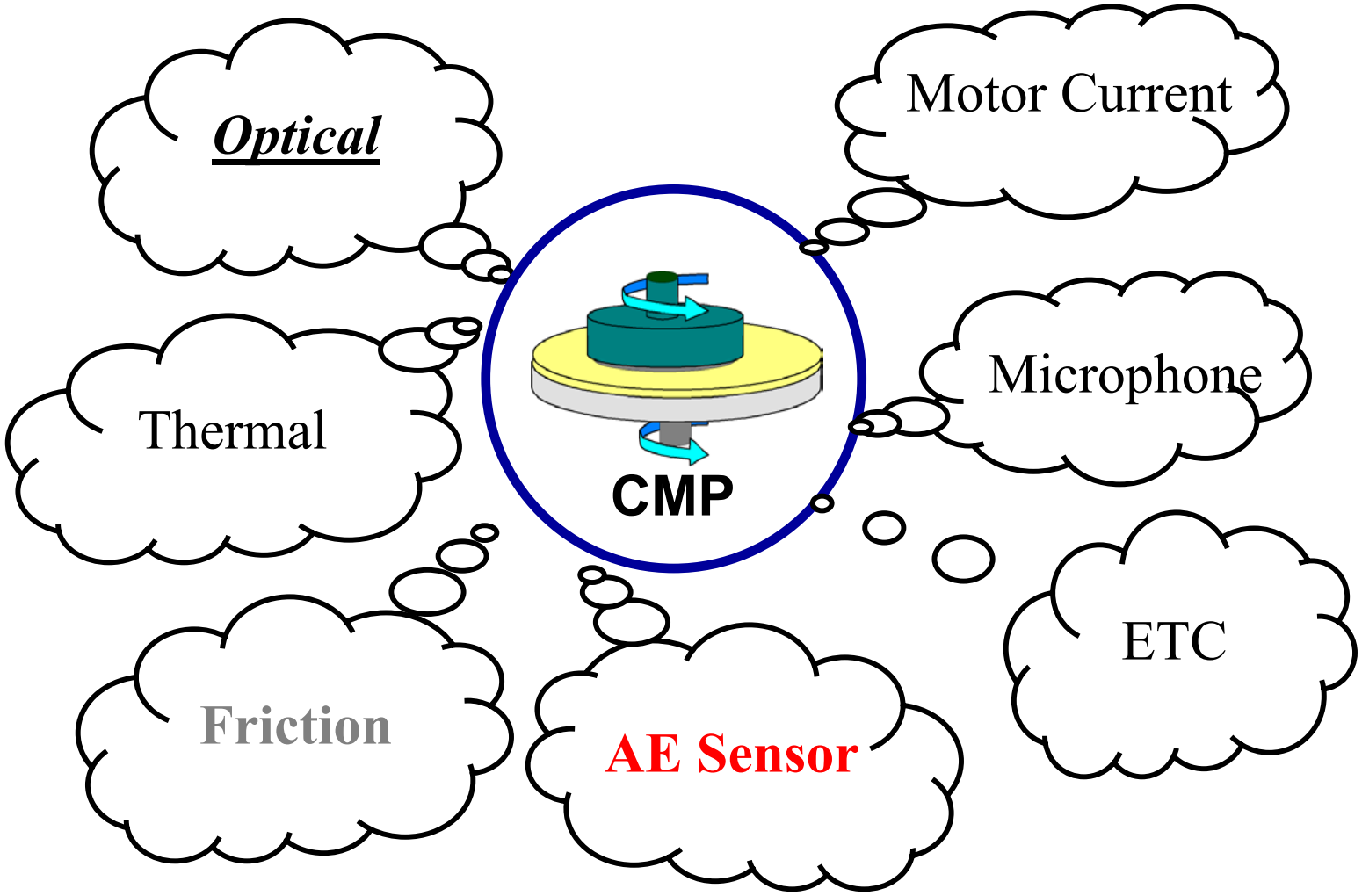


InterLevel Dielectric (ILD)

Oxide Only



EPD Methods

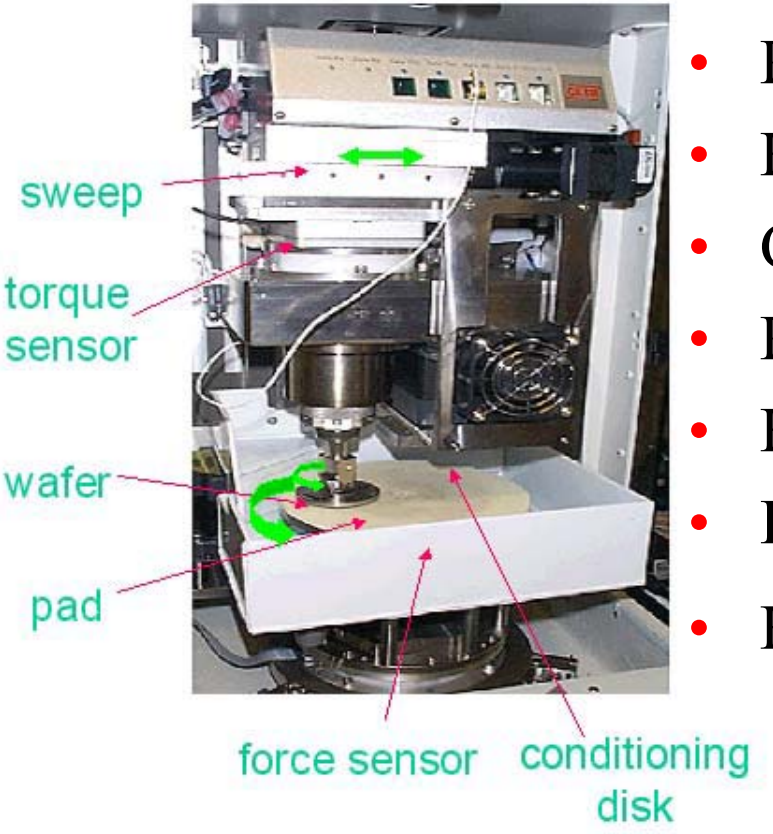

Optical
Motor Current
Thermal
Microphone
CMP
Friction
AE Sensor
ETC

EPD Methods – Cont'd

Methods	Physics	D,I	G,L	App
Optical	Reflectance, Absorption	D	L	Cu/STI/ILD
Thermal	Temperature Sensing	I	L	Cu/STI/ILD
Electrical	Motor Current	I	G	Cu/STI
Microphone	Intensity/ Freq. Analysis	D	G	Cu/STI/ILD
Force	**Friction Force**	**D/I**	**G**	Cu/STI
Acoustic Emission	**Acoustic Waves**	**D**	**G**	Cu/STI

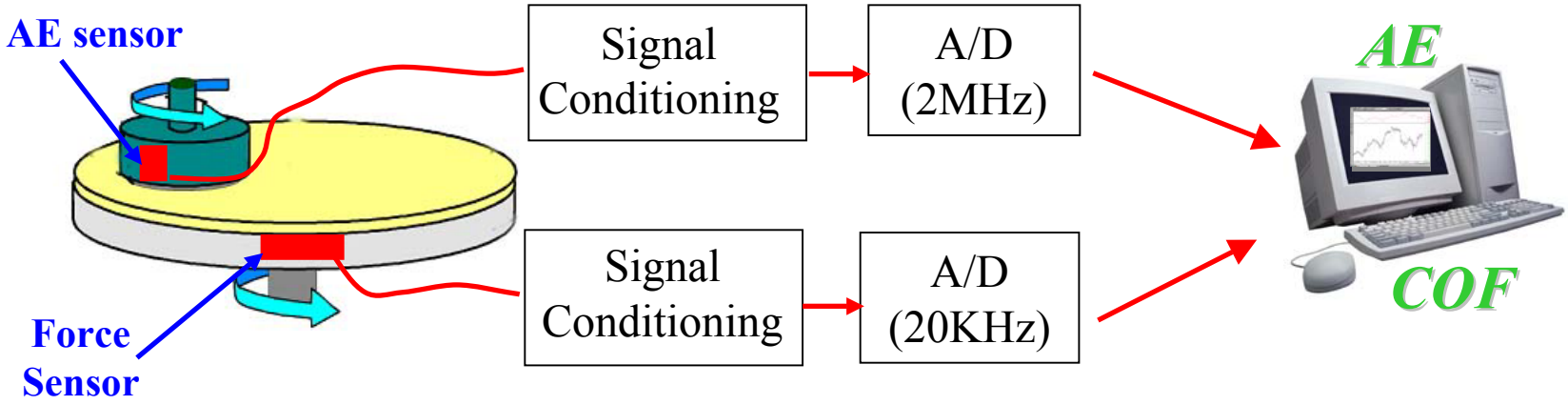
D: Direct, I: Indirect G: Global, L: Local

Experimental Setup – CETR Tool



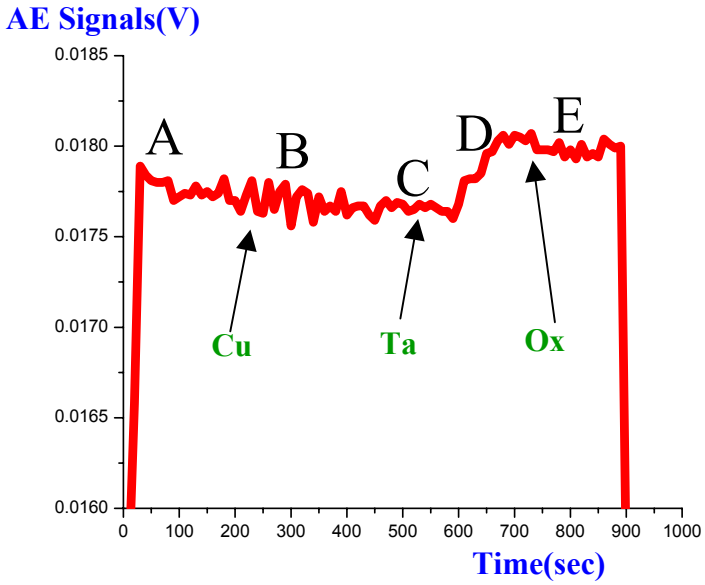
- Platen size: 6 in
- Head size: 2 in
- Condition disk size: 2.5 in
- Platen speed: 0.01- 1000 RPM
- Head speed: 0.01- 1000 RPM
- Load: 5 - 500N
- Head sliding speed: 0.01 - 10 in/sec

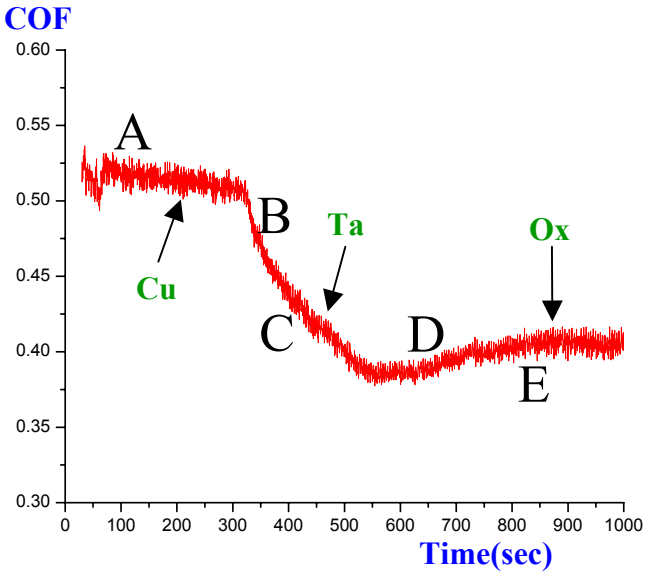
Experimental Setup – DAQ System

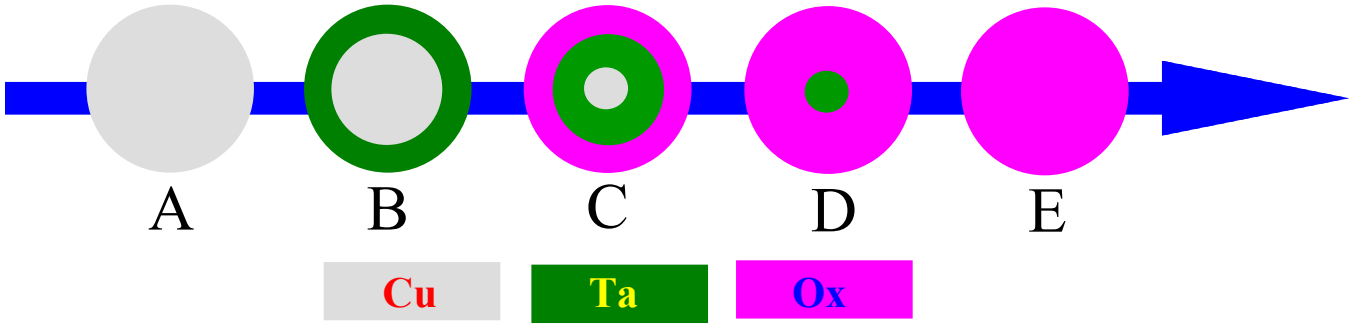


CMP Tool	CMP Tester by CETR
Test Wafers	Cu(1500Å)/Ta(250Å)/Ox(5000Å)
Slurry Type	Alumina based 5003 with 2.5% of H_2O_2
Pad Type	IC1000 Polyurethane Pad
Polishing Conditions	Down Force : 30 ~ 40N Table RPM: 60RPM

AE Data / Friction Data







Great Correlation Bet. AE and Friction Data

2002 and 2003 Goals

AE sensor shows a great potential for the EPD in CMP Process in terms of the selectivity between different materials as well as the sensitivity to the sub-micro material removal

Integrate initial chemical models into basic CMP model. Validate predicted development by 9/30/2002.

Develop comprehensive chemical and mechanical model. Perform experimental and metrological validation by 9/30/2003.