

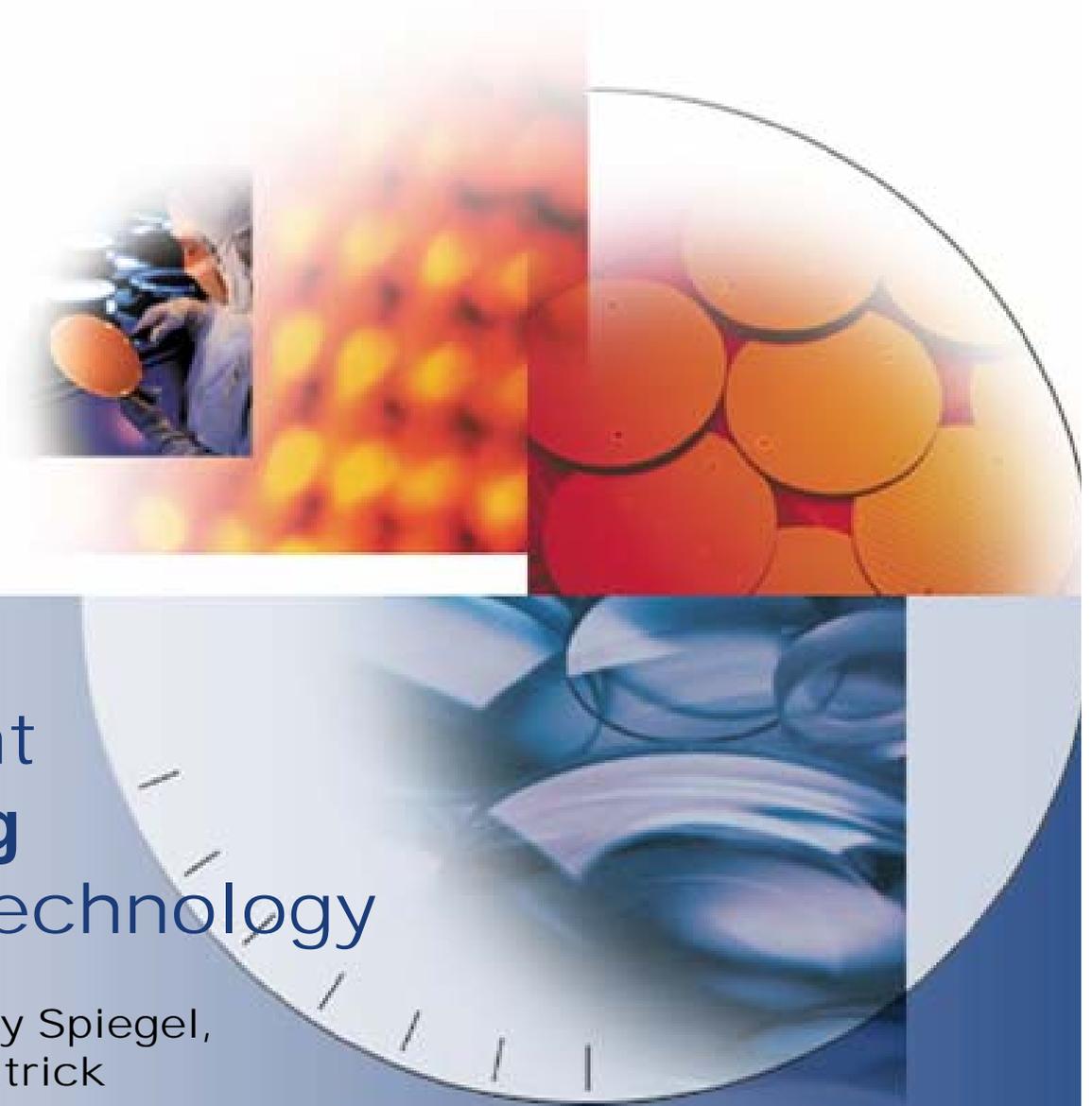


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CMP *n*Hancement Applications Using ViPRR Carrier Technology

Lily Yao, Bill Kalenian, Larry Spiegel,
Bryan Sennett, Mike Kirkpatrick

bkalen@strasbaugh.com

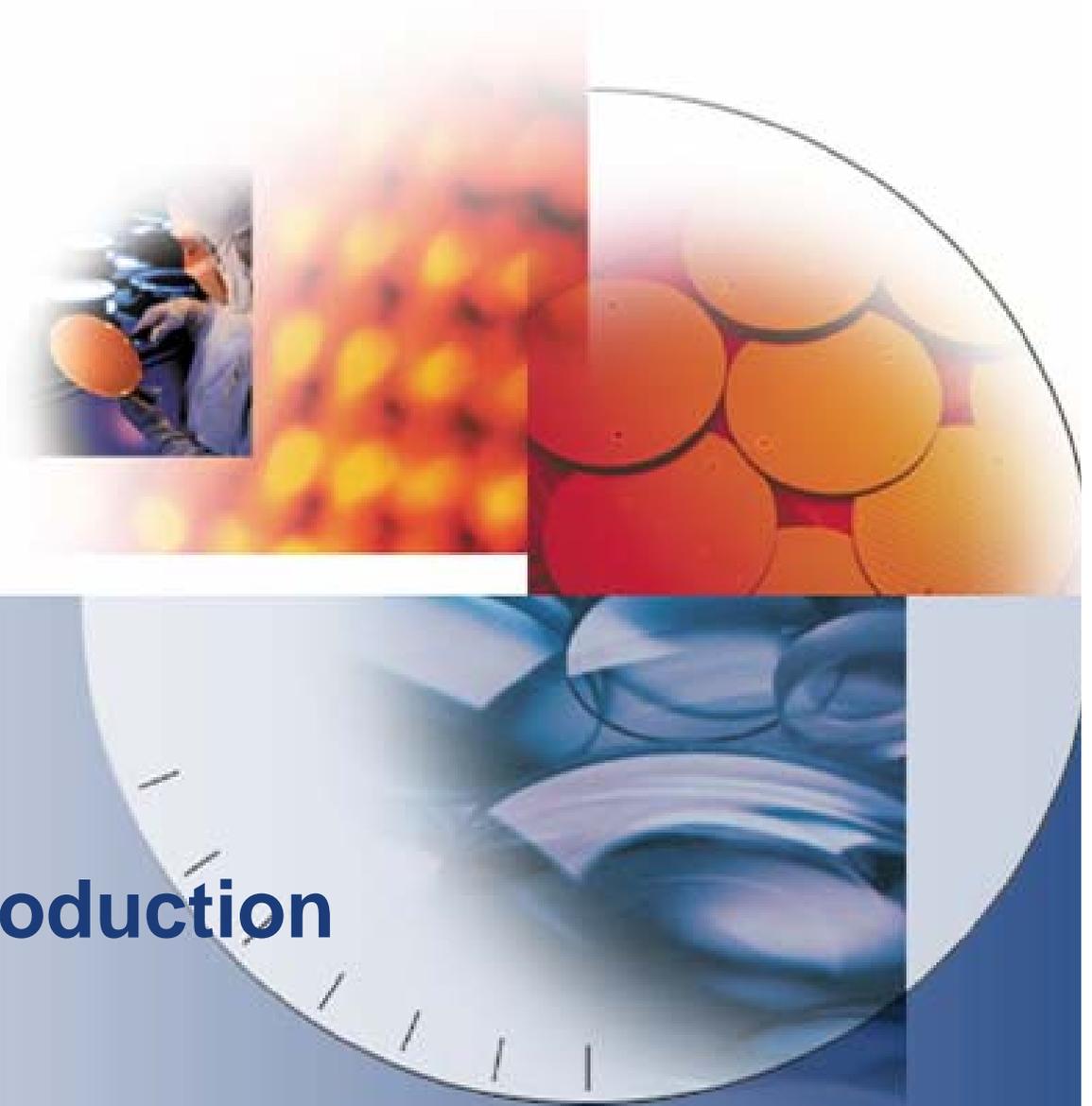


Discussion agenda

- **Strasbaugh Introduction**
- **ViPRR Carrier Technology & CMP nHancement Program**
- **ViPRR & CMP nHancement Applications**
 - IC Manufacturing
 - Thin Film Head (TFH) Manufacturing
 - Failure Analysis (FA)
 - Research & Development
- **Summary**



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Strasbaugh Introduction

Strasbaugh Introduction

- **Founded in 1948, Strasbaugh has more than 50 years experience designing, innovating and manufacturing precision surfacing systems**
- **Over 15,000 polishing and grinding systems manufactured to date**
- **Over 45 models available today for use in diverse high-technology markets**
- **Headquarters in San Luis Obispo, California
Representation throughout the world**

Strasbaugh CMP Product Line



nTrepid (6EH)
150-300mm



nTegrity (6DSSP)
75-200mm



nHance (6EG)
150-300mm



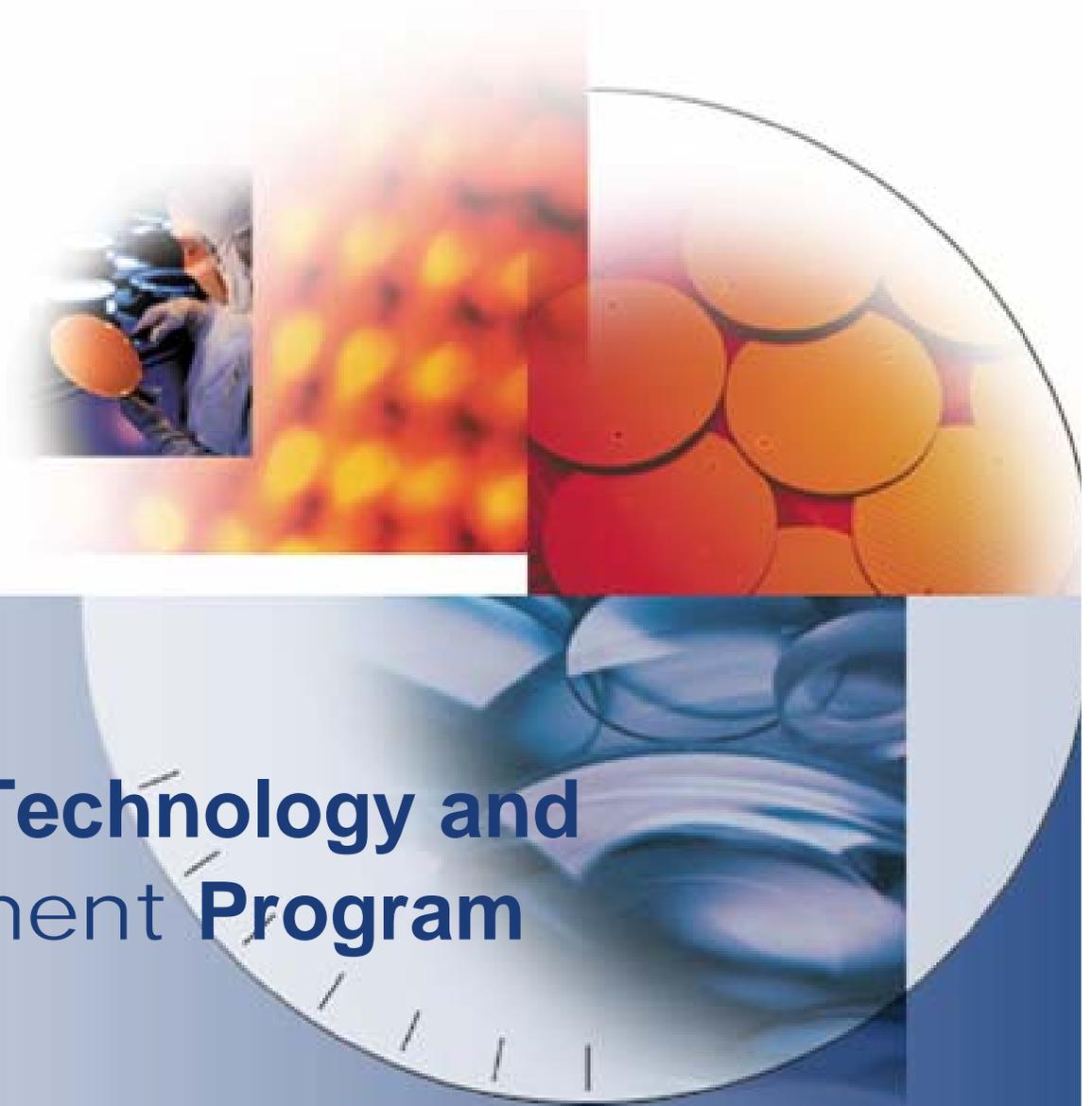
nSpire (6EC)
75-200mm



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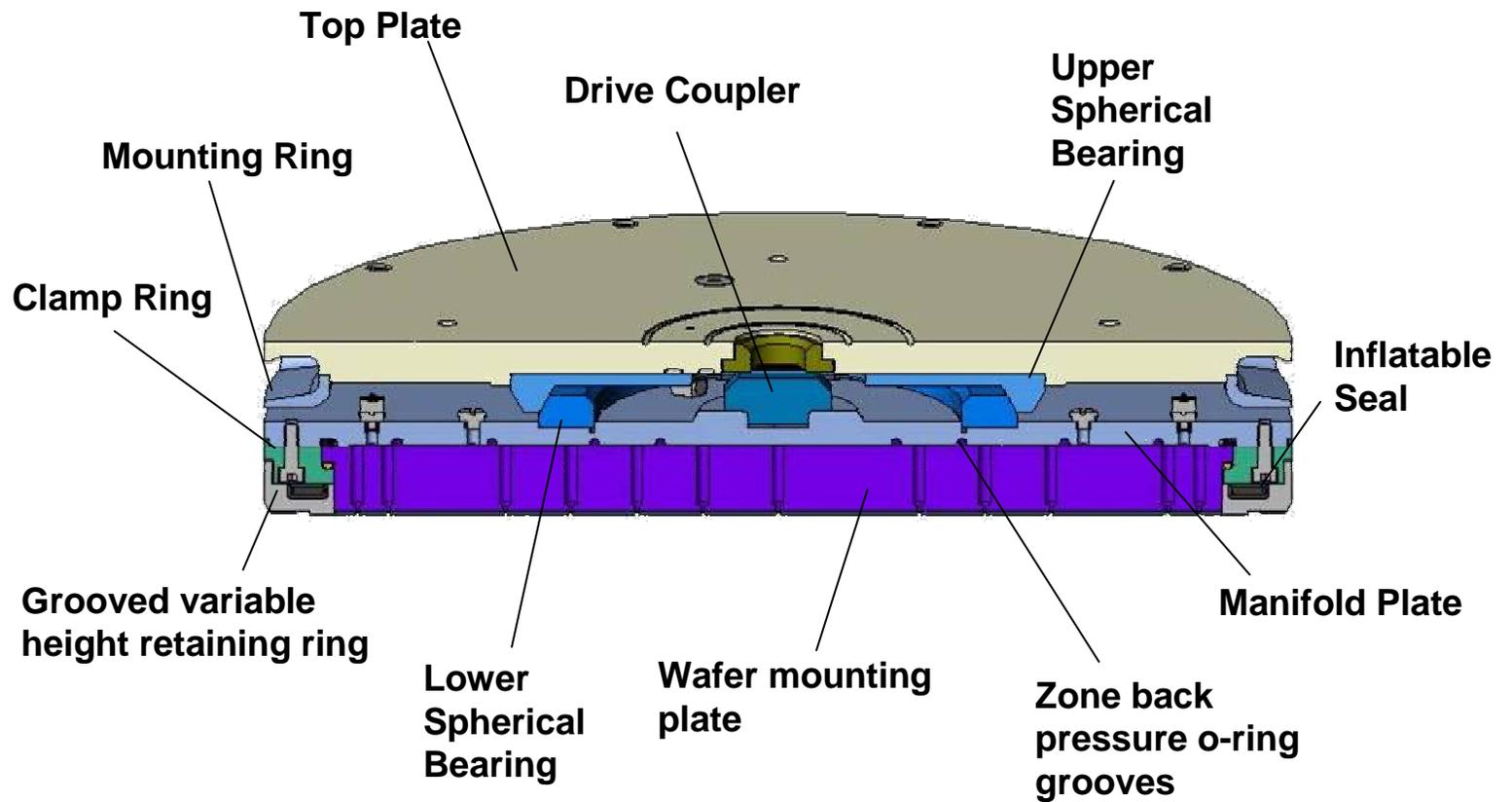
ViPRR Carrier Technology and CMP *n*Hancement Program

ViPRR Wafer Carrier

- **Strasbaugh first introduced ViPRR Carrier in 1997**
 - Design featured ball & socket gimbal mechanism, post in hole rotational drive, and a pneumatic retaining ring
- **Since then, Strasbaugh has released a series of ViPRR carriers, including ViPRR II, III, and most recently the ViPRR IV Carrier**
- **ViPRR IV has been successfully implemented for a variety of wafer sizes on both Strasbaugh CMP machines as well as IPEC 372 and 472 polishers.**
- **The IPEC ViPRR IV and related control hardware have been named:**

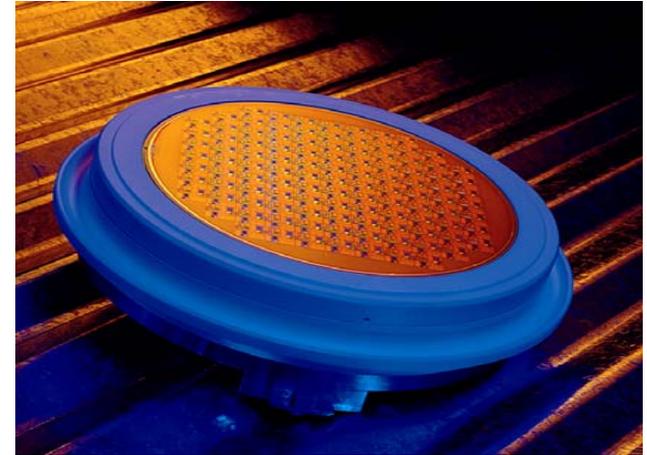
“CMP *n*Hancement” or “CMPE”

ViPRR IV Wafer Carrier



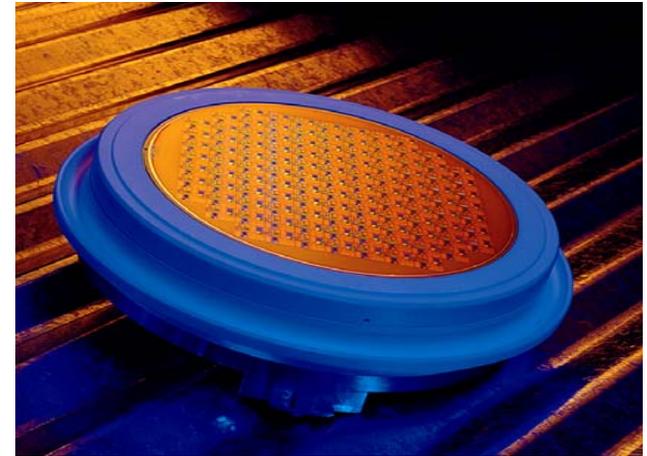
ViPRR IV Carrier Design Features

- **Projected gimbal**
 - Improves wafer to pad alignment for enhanced CTE uniformity, slurry distribution, edge exclusion, increased resistance to vibration, and flatter retaining ring wear
- **Pneumatically-controlled ViPRR retaining ring**
 - Pre-compresses polish pad ahead of the wafer, controlling pad rebound effect and improving uniformity to 3mm edge exclusion or better
- **Angular pick-up**
 - Prevents “suction cupping” at the polish pad during wafer pick-up

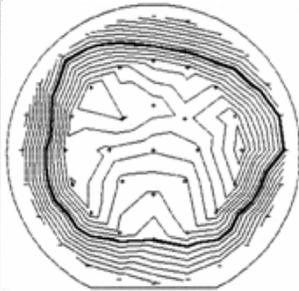


ViPRR IV Carrier Design Features

- **Zone back pressure**
 - Controls center to edge uniformity using two or three zones of control
- **Few moving parts**
 - For higher reliability, simplified carrier maintenance, and extended process stability
- **Grooves in the retaining ring**
 - Improves slurry distribution, reduces heat generation at polish pad
- **Proven in production**
 - Original ViPRR I carrier released in 1997



ViPRR- Zone Back Pressure



Center Fast Polishing
Positive Back Pressure



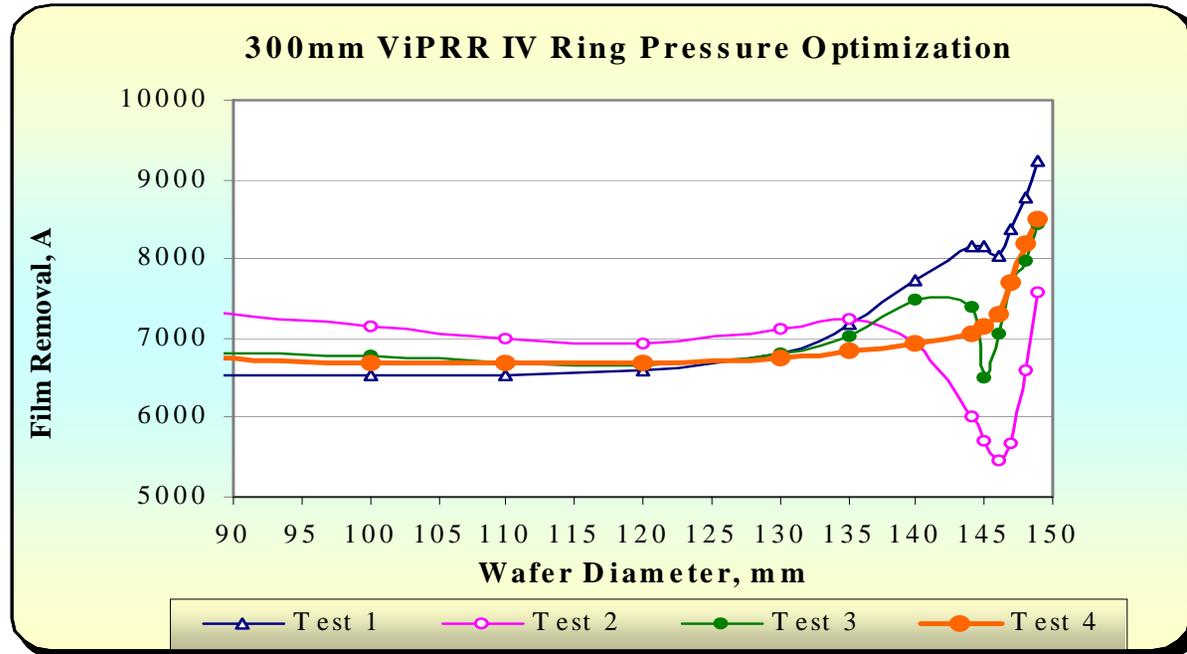
Center Slow Polishing
Negative Back Pressure



Uniform Polishing
2.8% 1 sigma

- Allows air back pressure to be applied selectively to circumferential zones within the carrier
- Provides air cushion and pressure between wafer and carrier backing film in order to improve center-to-edge WIWNU
- ViPRR's design allows precisely controlled back pressure to be applied to the wafer through the backing film

ViPRR- Pneumatic Retaining Ring

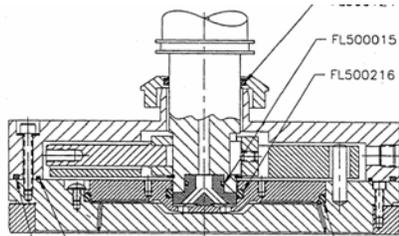


Rem Within-Wafer-Non-Uniformity				
	5mmEE	3mmEE	2mmEE	1mmEE
Test 1	8.89%	10.62%	11.85%	12.96%
Test 2	6.43%	8.95%	9.76%	11.85%
Test 3	2.92%	4.13%	6.82%	8.65%
Test 4	1.96%	3.06%	4.65%	7.51%

ViPRR / IPEC Carrier Comparison

Strasbaugh ViPRR Carrier	IPEC Carrier
Zone back pressure uniformity control and air cushioning	No zones for uniformity control
Pneumatically controlled retaining ring force	No edge exclusion technology
Low friction projected gimbaling and drive mechanisms	O-ring & T-bar rotation cause friction in gimbal
Center of gimbal at pad/wafer interface	Gimbaling occurs above the pad
Simple backing film installation using alignment pins	No backing film alignment method
Advanced materials for reliability and durability	Legacy technology using legacy materials

CMPE for IPEC Tools using ViPRR Carrier

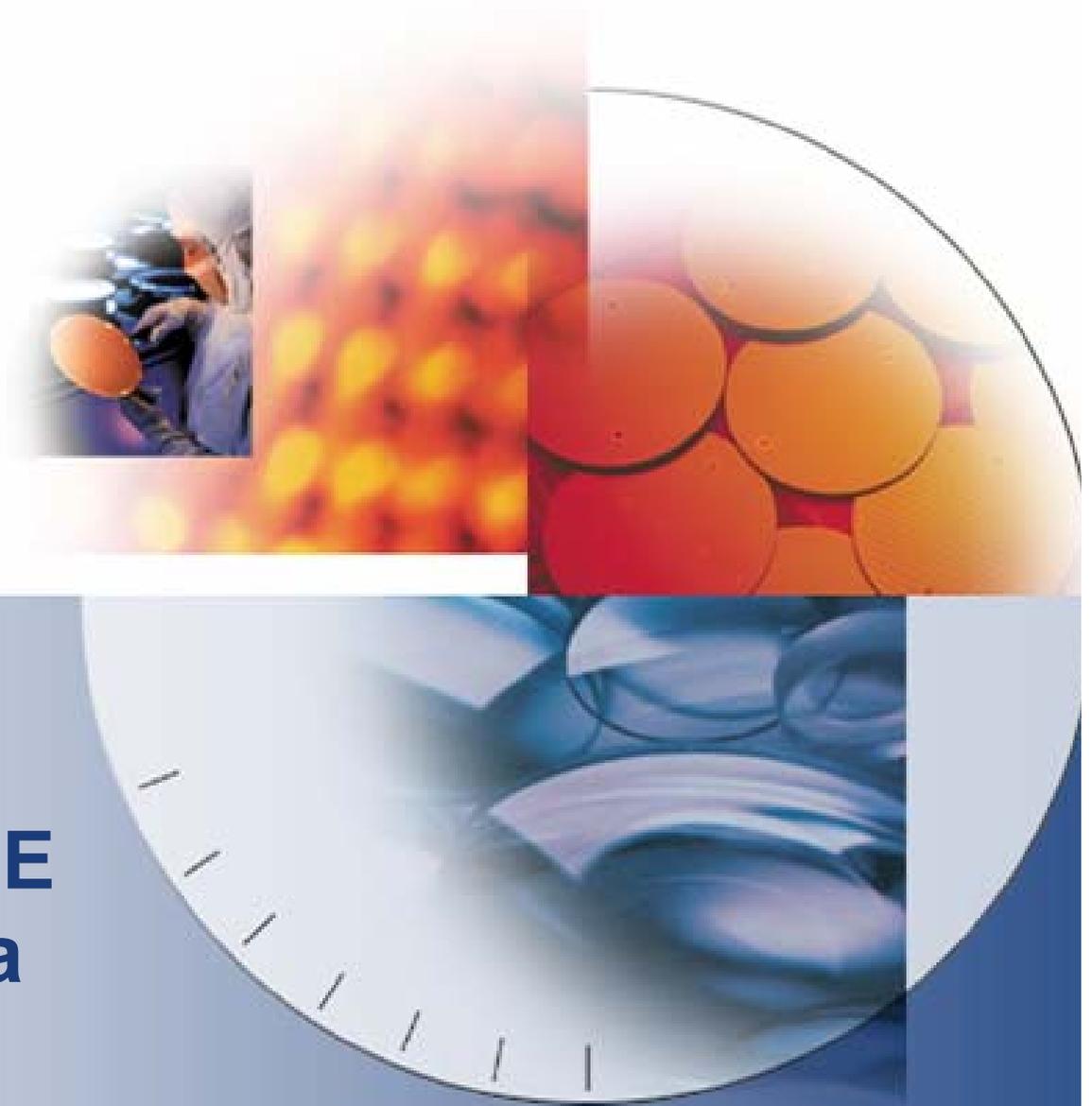


- **ViPRR IV carrier implementation onto IPEC 372 & 472 CMP machines for Oxide and MEMS applications**

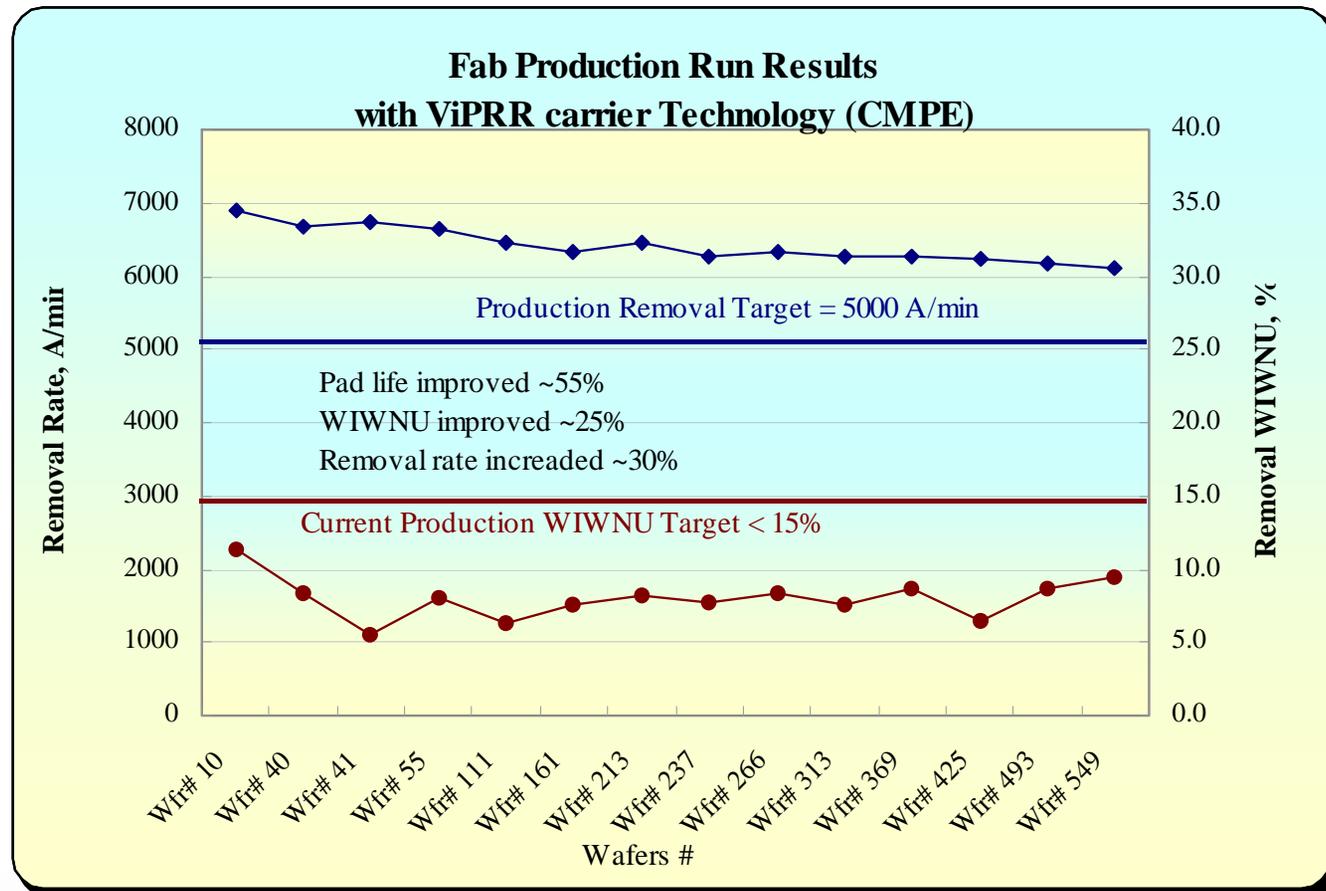


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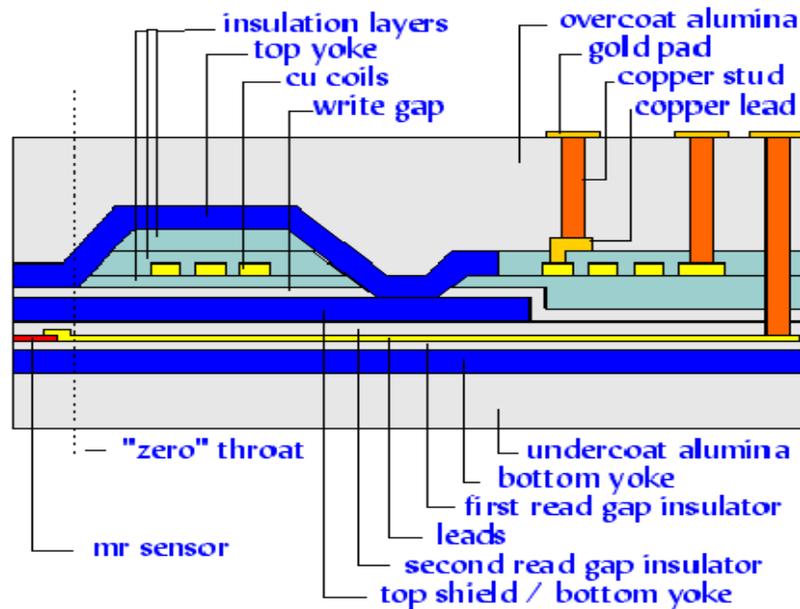
ViPRR and CMPE Application Data



ViPRR CMPE, Oxide Production Application



TFH CMP Using ViPRR Carrier



- As dimensions in thin film magnetic read/write heads become smaller, the CMP process has become critical to the manufacturing-process:
- Lower layer CMP
 - Smooth Al₂O₃ surface on AlTiC substrate
 - Smooth, defect-free surface (Al₂O₃ & NiFe) for reader track-definition photolithography control
- Upper layer CMP
 - OC CMP – CMP (Al₂O₃ and Cu) to open up Cu studs for gold bond pads plating

TFH CMP Using ViPRR Carrier

- **Lower layer surface roughness (Ra) results:**

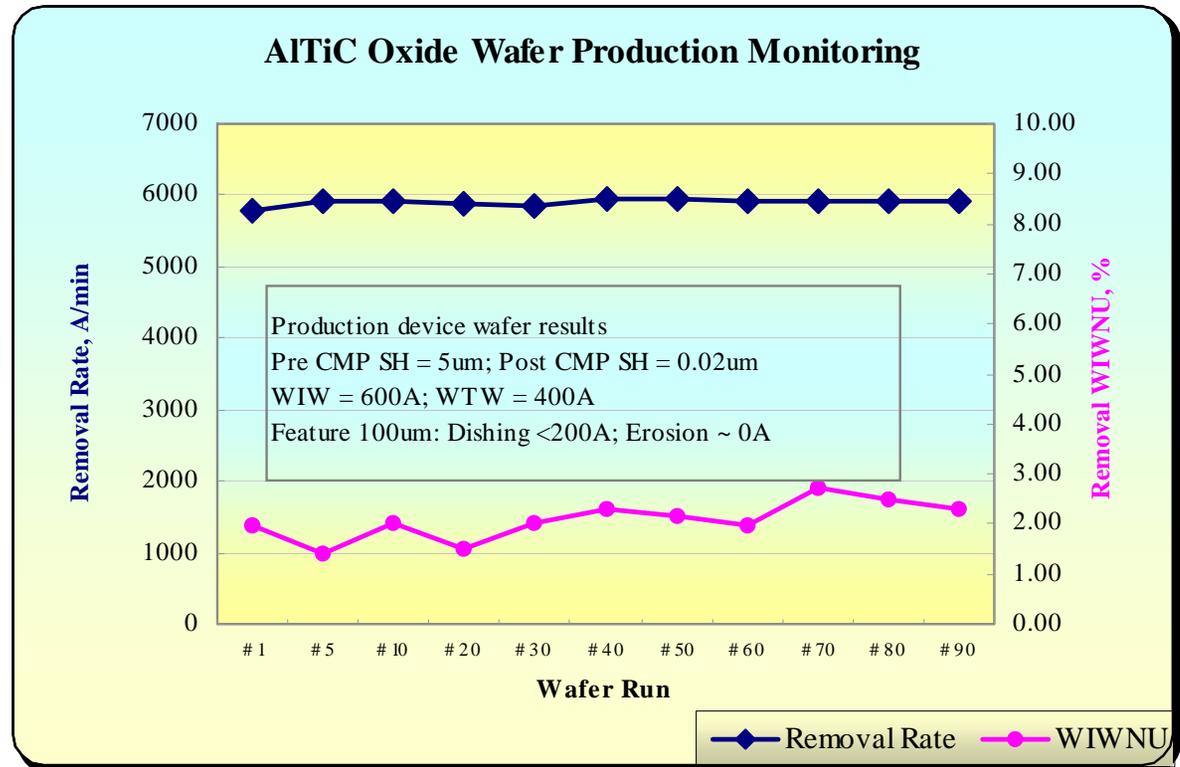
- Pre surface Ra=3nm;
- Post CMP Ra<0.2nm

- **Upper layer Step Height (SH) results:**

- Pre SH ~5um;
- Post SH<0.02um

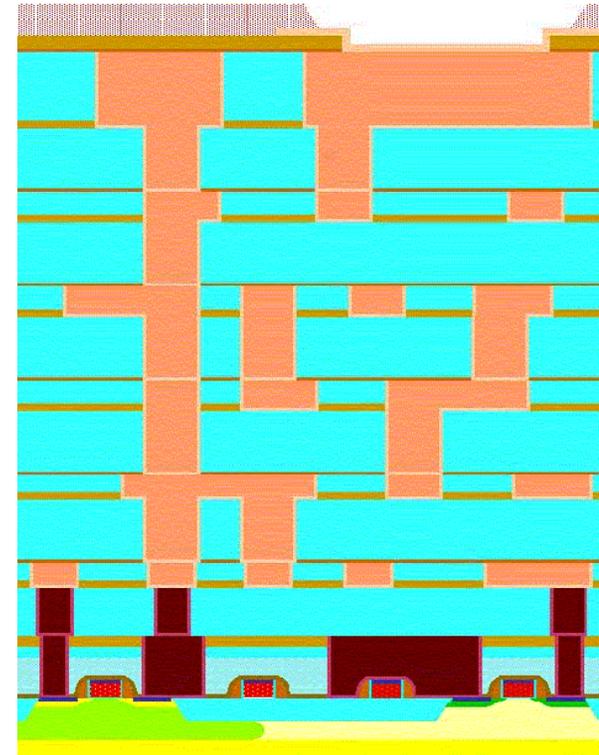
- **Blanket monitor ThK variation 1σ results:**

- WIW = 60nm
- WTW = 40nm



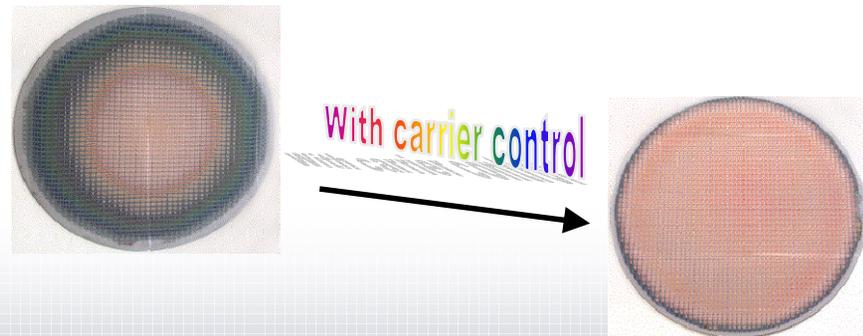
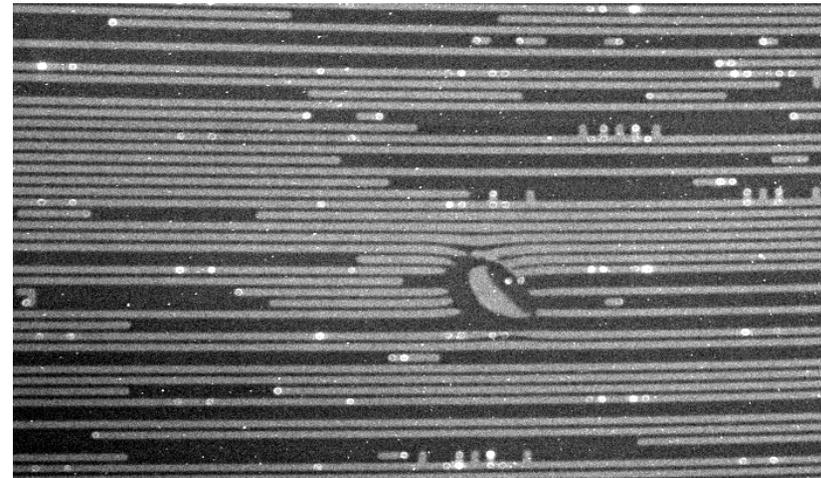
FA – WWD Applications Using ViPRR

- **FA is widely used in IC manufacturing to shorten yield learning cycles**
- **Previous FA sample preparation methods had shortcomings:**
 - RIE/wet etch processes resulted in planarity/topology control loss
 - Grinding (mechanical polishing) was a very slow process
 - *Samples often prepared one die at a time*
 - *Could take up to a week to prepare a wafer for analysis*



FA – WWD Applications Using ViPRR

- **Whole wafer deconstruct (WWD) using CMP technology was developed to reduced sample preparation time, allowing much quicker response time, throughput, and lower cost.**
 - ViPRR added the necessary process improvements for uniformity (within wafer and die)
 - Sample preparation time reduced from days to hours
 - The advantage of quickly preparing wafers for FA has been recognized and has contributed much to the success of yield ramping



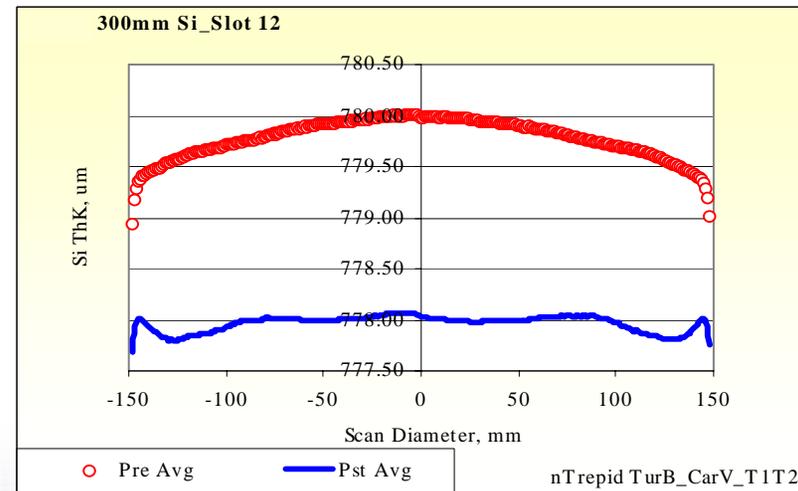
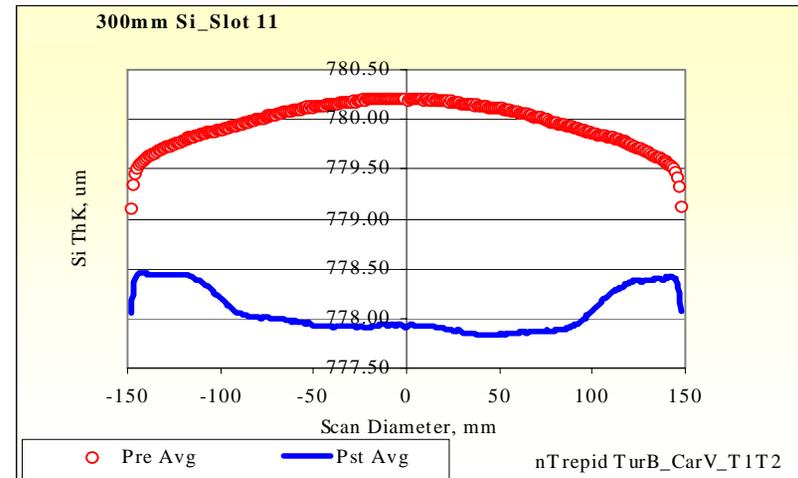
Silicon Haze Removal Using ViPRR & ZBP

- **Example 1- Center fast**

- Set Zone 1 (outer) = Low pressure
- Set Zone 2 (inner) = High pressure

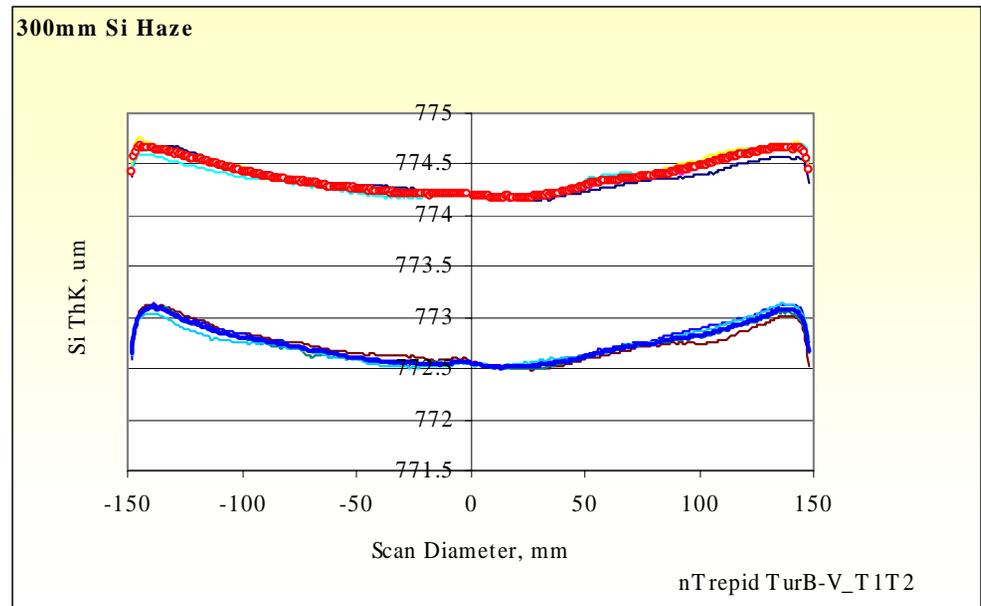
- **Example 2- Edge fast**

- Set Zone 1 (outer) = High pressure
- Set Zone 2 (inner) = Low Pressure



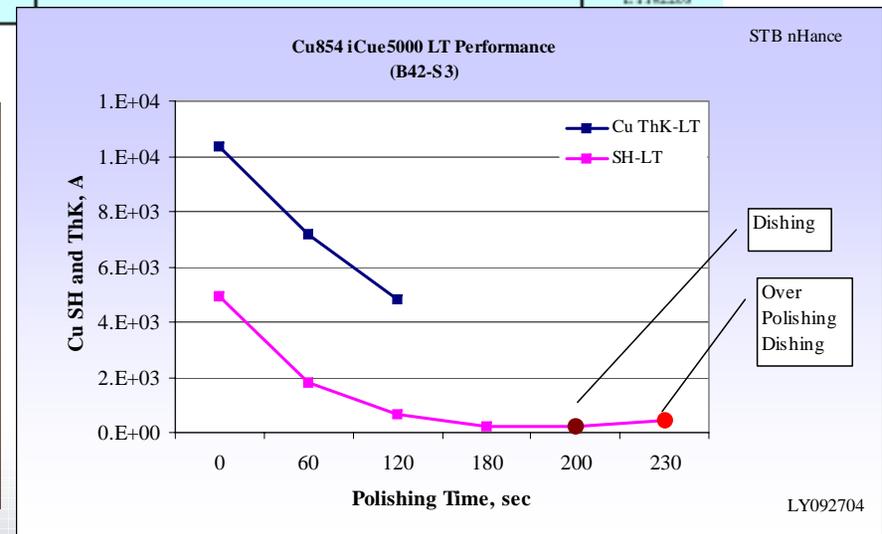
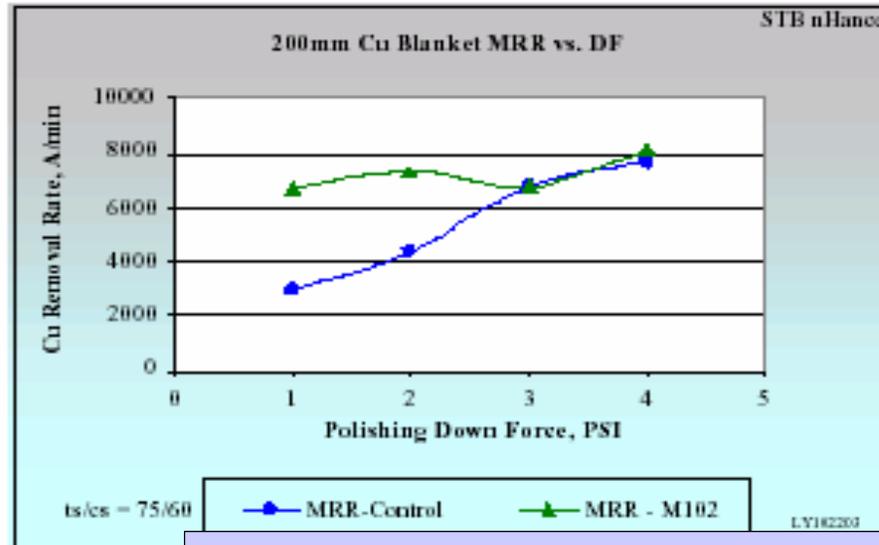
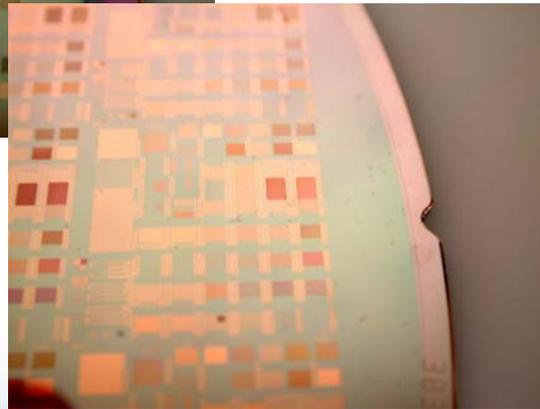
Silicon Haze Removal Using ViPRR and ZBP

- **Example 3- equal removal across wafer**
 - Back pressure zones 1 and 2 are optimized for uniform Silicon removal



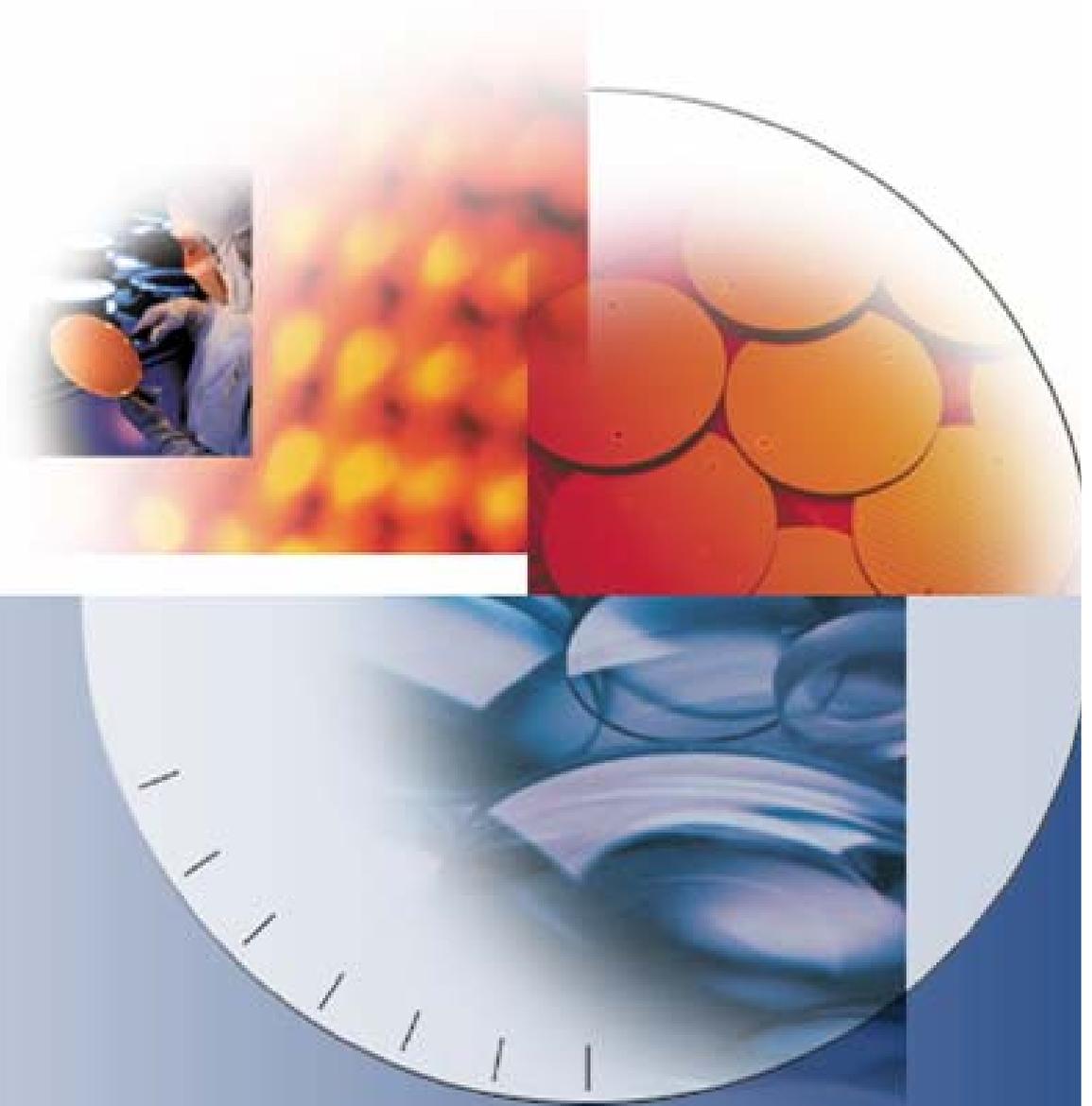
ViPRR for R&D Applications

- Cu slurry development with Strasbaugh *n*Hance Polisher and ViPRR carrier technology





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Summary

Summary

- **Strasbaugh's ViPRR carrier technology has been successfully implemented on Strasbaugh and IPEC CMP equipment for many polishing applications including:**
 - IC production applications
 - TFH fabrication
 - Whole Wafer Deconstruct for FA
 - Si primary wafer applications
 - MEMS
 - R&D (slurry, pads, film materials, substrate, etc.)
- **ViPRR carrier technology has functioned well for many wafer sizes from as small as 75mm up to 300mm**

Summary

- **The VIPRR IV design combines ZBP, spherical gimbal, and wafer edge profile control that has yielded state of the art WIWNU performance at an edge exclusion of less than 3mm for many applications**
- **VIPRR IV's projected gimbal design provides improved carrier stability and performance and reduces vibration in high friction processes**
- **The CMPE program has extended the useable life of many IPEC 372 and 472 polishers, bringing up-to-date carrier performance to a solid platform.**