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STRATEGICALLY DESIGNED PLANARITY MATERIALS

Novel CMP Pad for Tungsten Polishing

ERC TeleSeminar
March 24, 2005

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Agenda

- Background on pad benefits, features, and architecture
- Current pad technology
- Pad performance
- Future pad technology

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History and Philosophy

- Commercial goal – create CMP polishing pad business
- Barrier – entrenched technologies and suppliers difficult to displace
- Constraints – Polyurethane IP field dominated by R&H
- Concept – improve overall performance and lower CoO without copying existing technology
- Target – users or applications for whom "one size fits all" approach is not the best
  → provide alternative to existing CMP pad
- R&D History – many materials, surface treatments, composite structures examined

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W CMP Generally Expected Performance

- 2,500 – 4,000 Å/min removal rate
- <5% WIWNU
- <20 particles added
- <200 Å Dishing
- <200 Å Erosion
- <100 Å/min oxide removal rate
- >1,000 polishing minutes pad life

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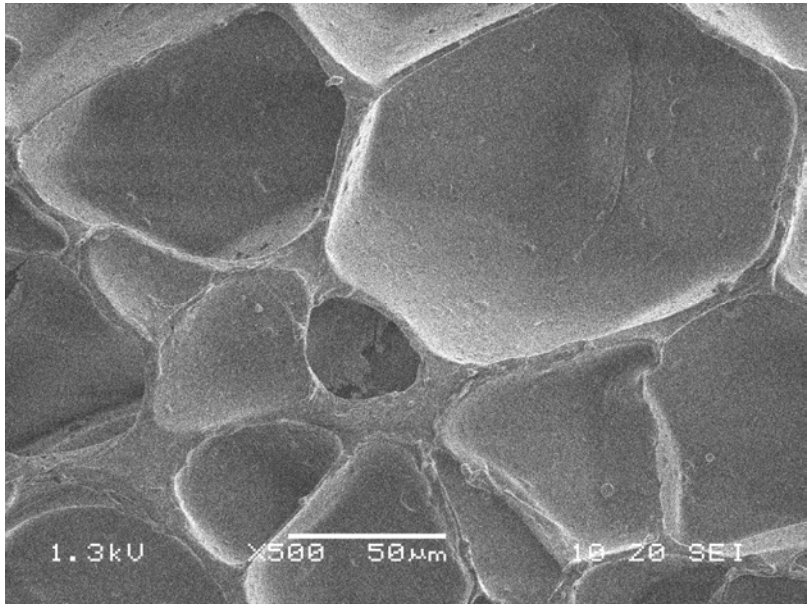
Tungsten Polishing Pad
Features and Benefits

Application Specific Pad

- Polyolefin foam pad
- Closed cell structure for surface texture
- No diamond conditioning
- Very low defects
- Long life
- Low Cost of Ownership

Pad Architecture



Cell structure and construction similar for all pads

Cell size ≈ 150 µm

- Thermoplastic Foam Surface Pad
- Co-extruded Hard-cap Sub-pad
- Glue Layer Type A
- Mylar Interposer
- Glue Layer Type B

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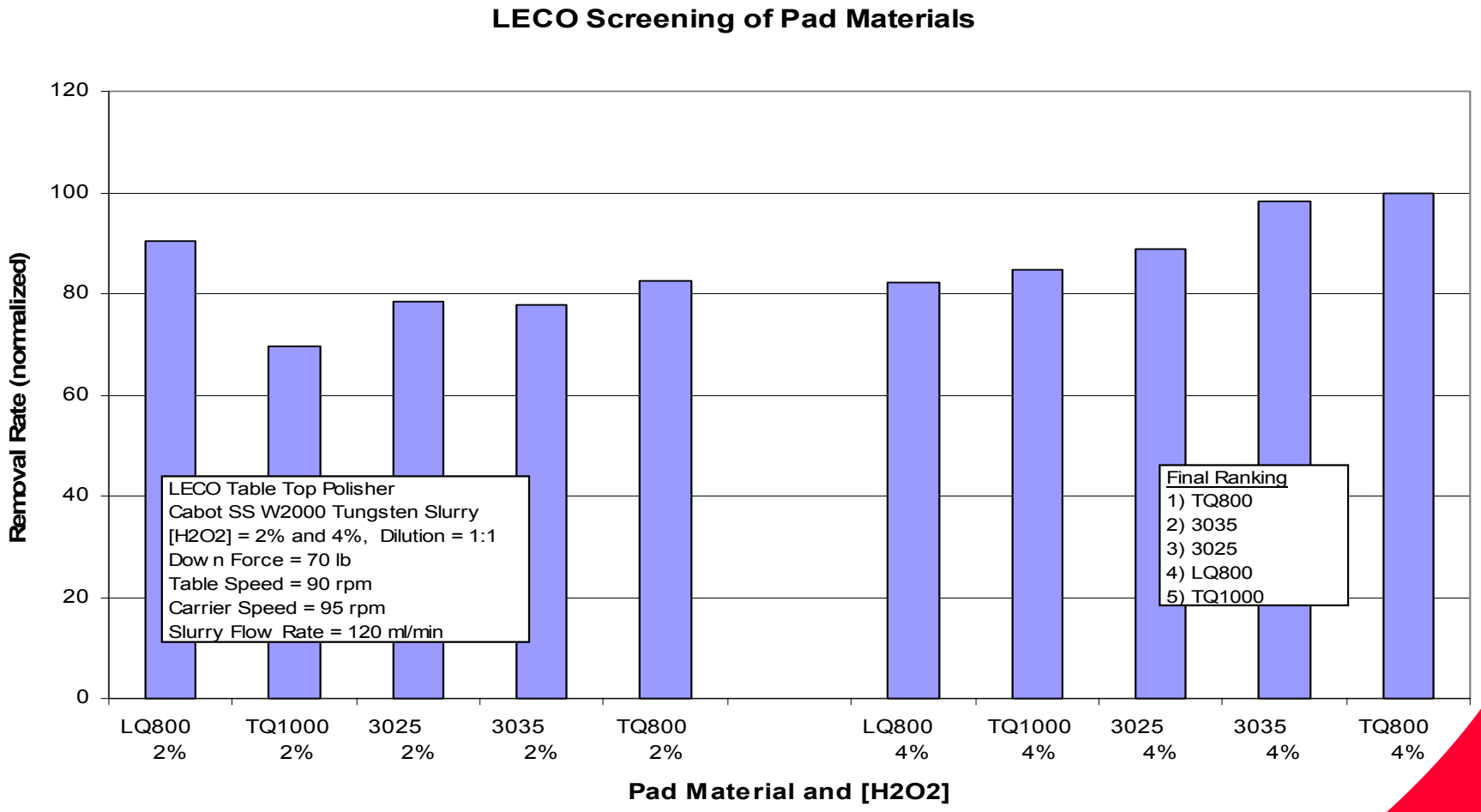
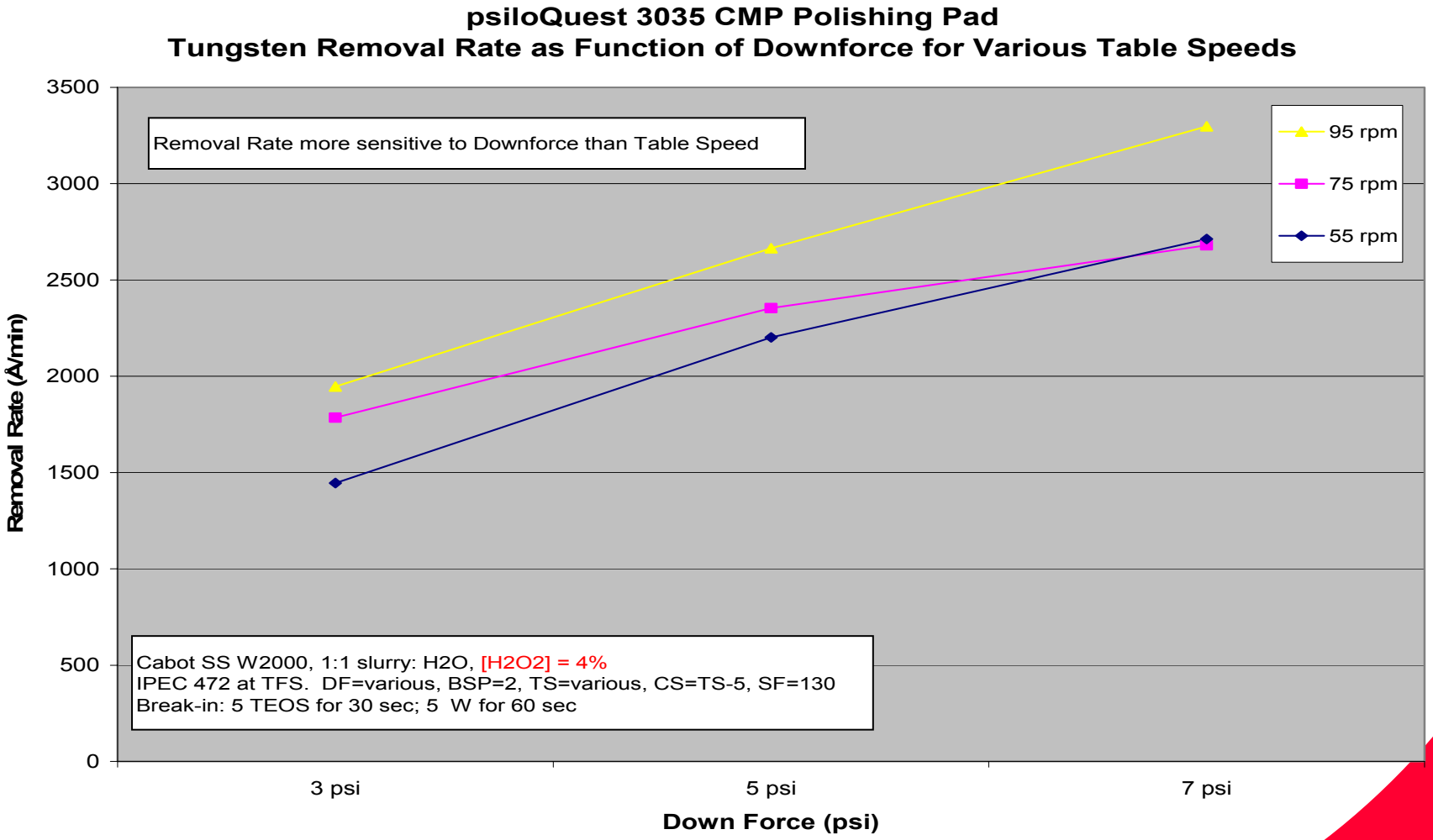
LECO Screening
12-inch Table Top Polisher



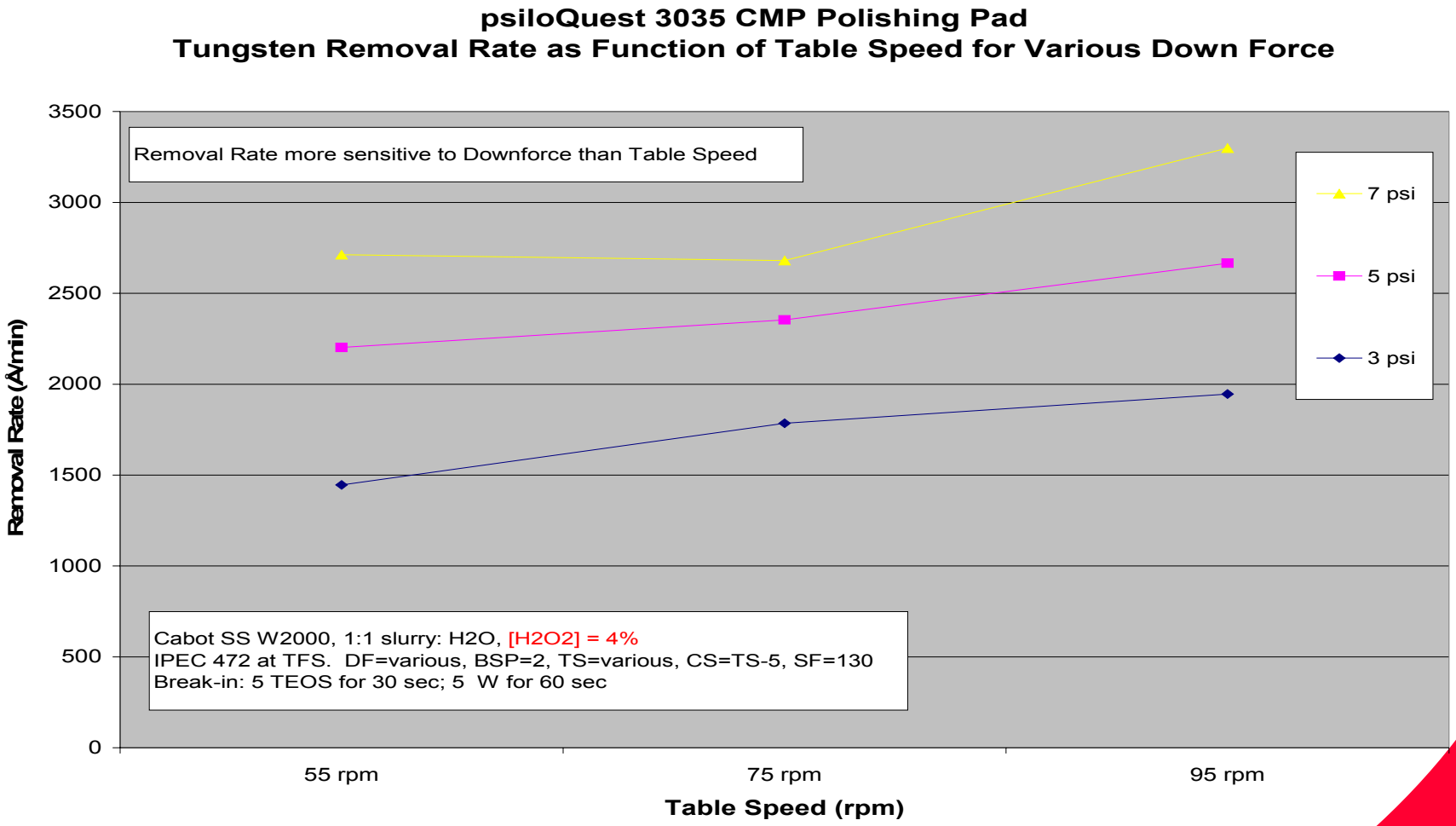
DOE for polisher conditions

Removal Rate as f(Down Force)



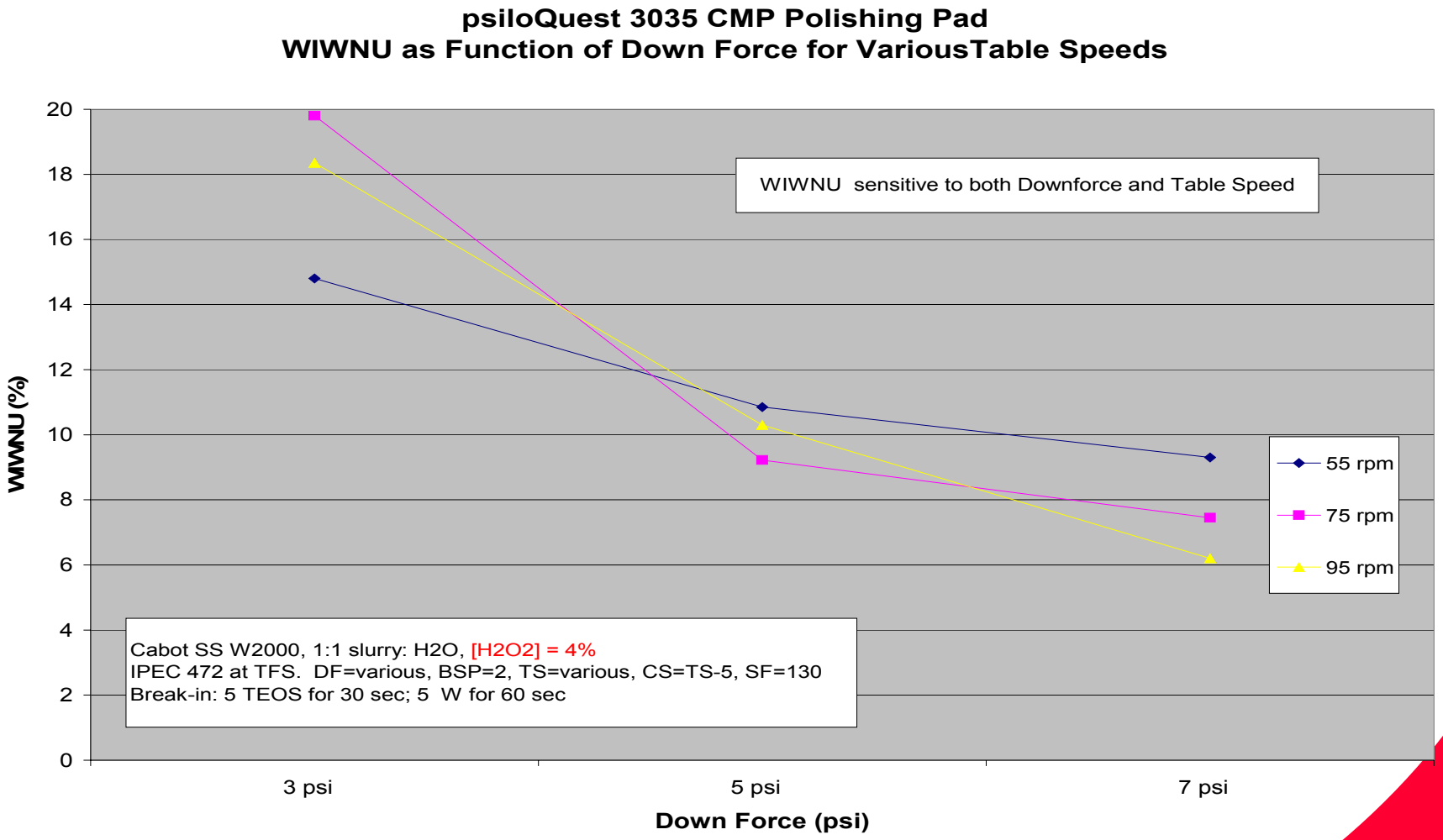
DOE for polisher conditions

Removal Rate as f(Table Speed)



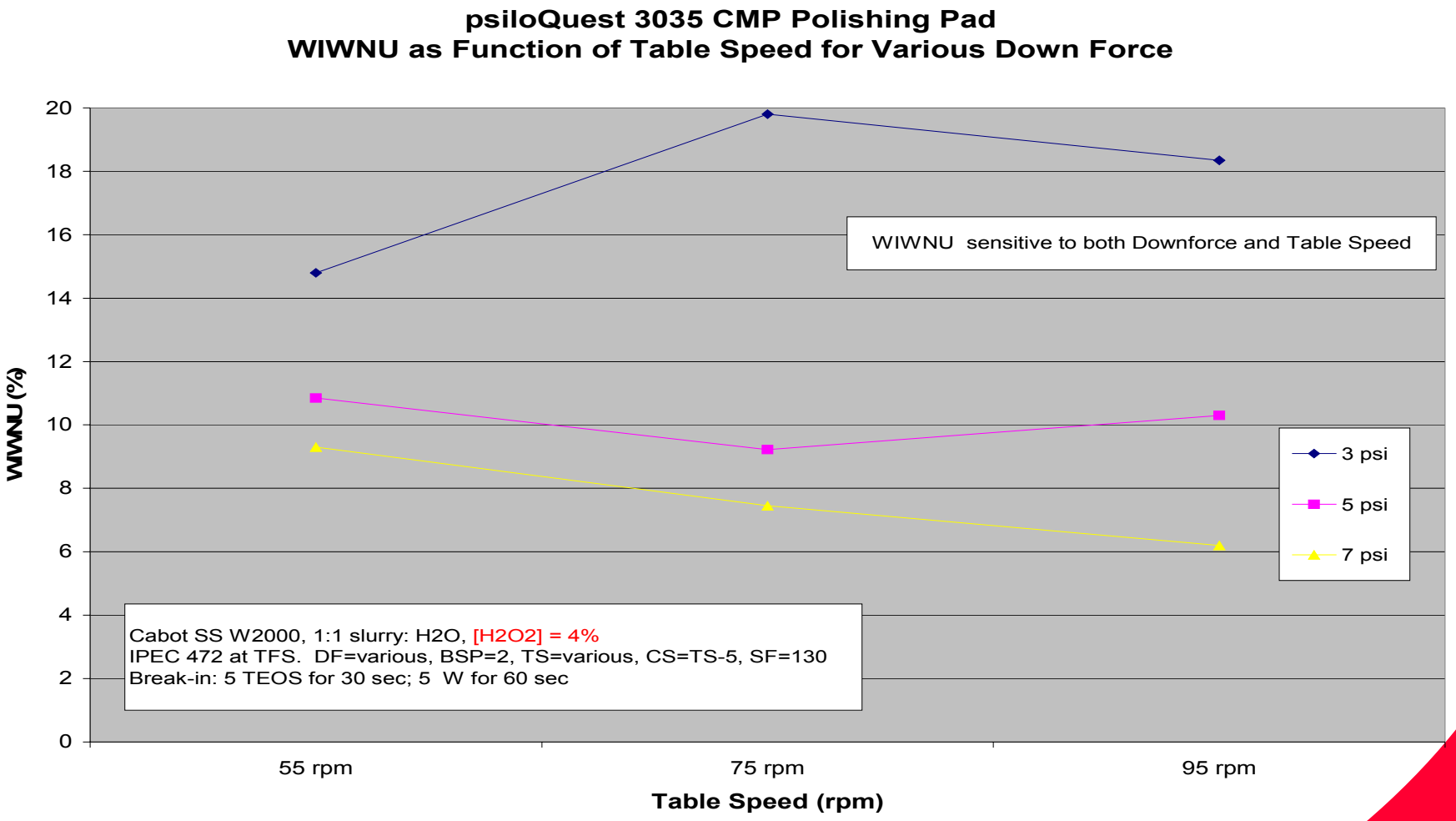
DOE for polisher conditions

WIWNU as f(Down Force)

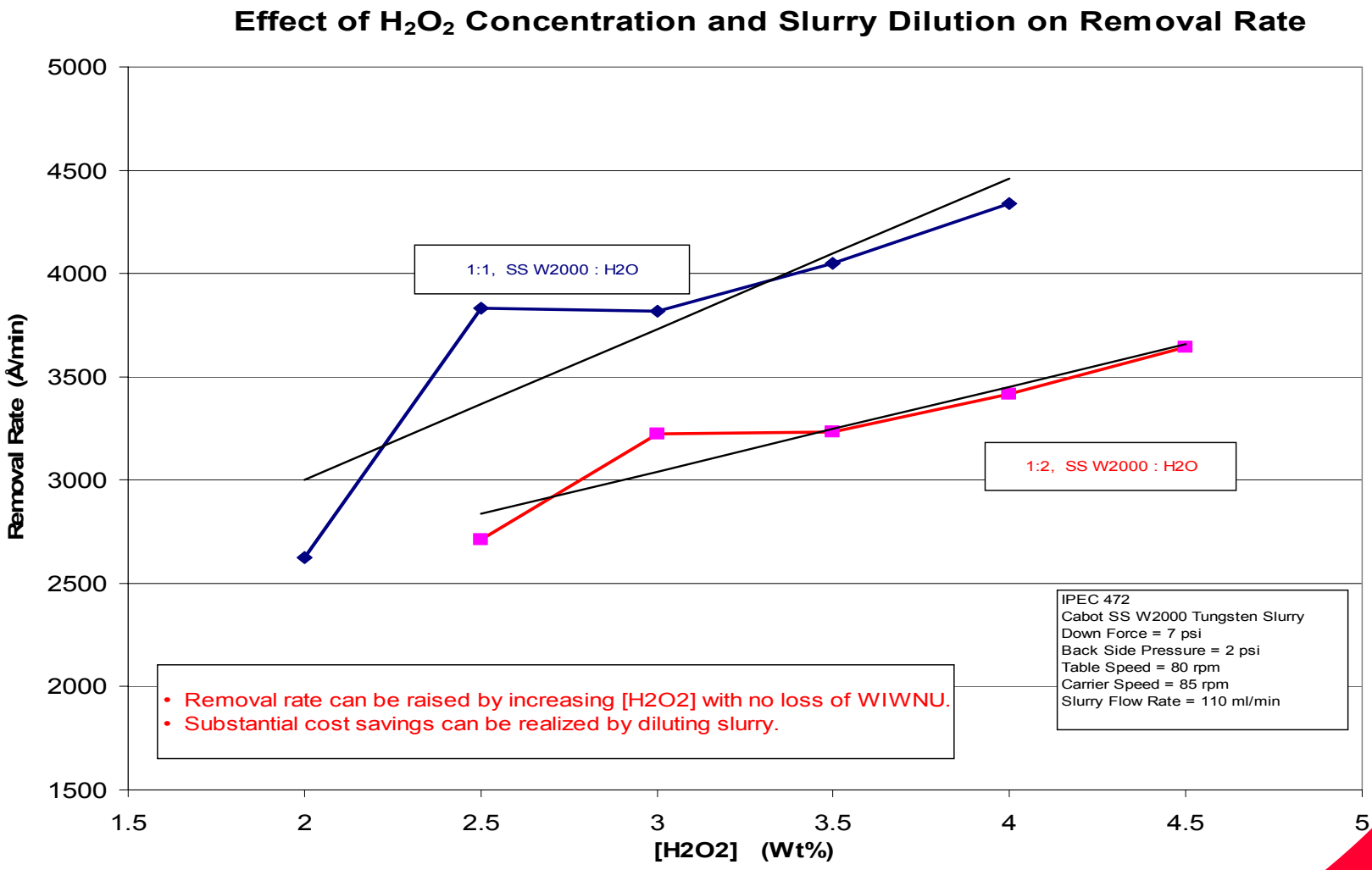


DOE for polisher conditions

WIWNU as f(Table Speed)



$[H_2O_2]$ and Slurry Dilution



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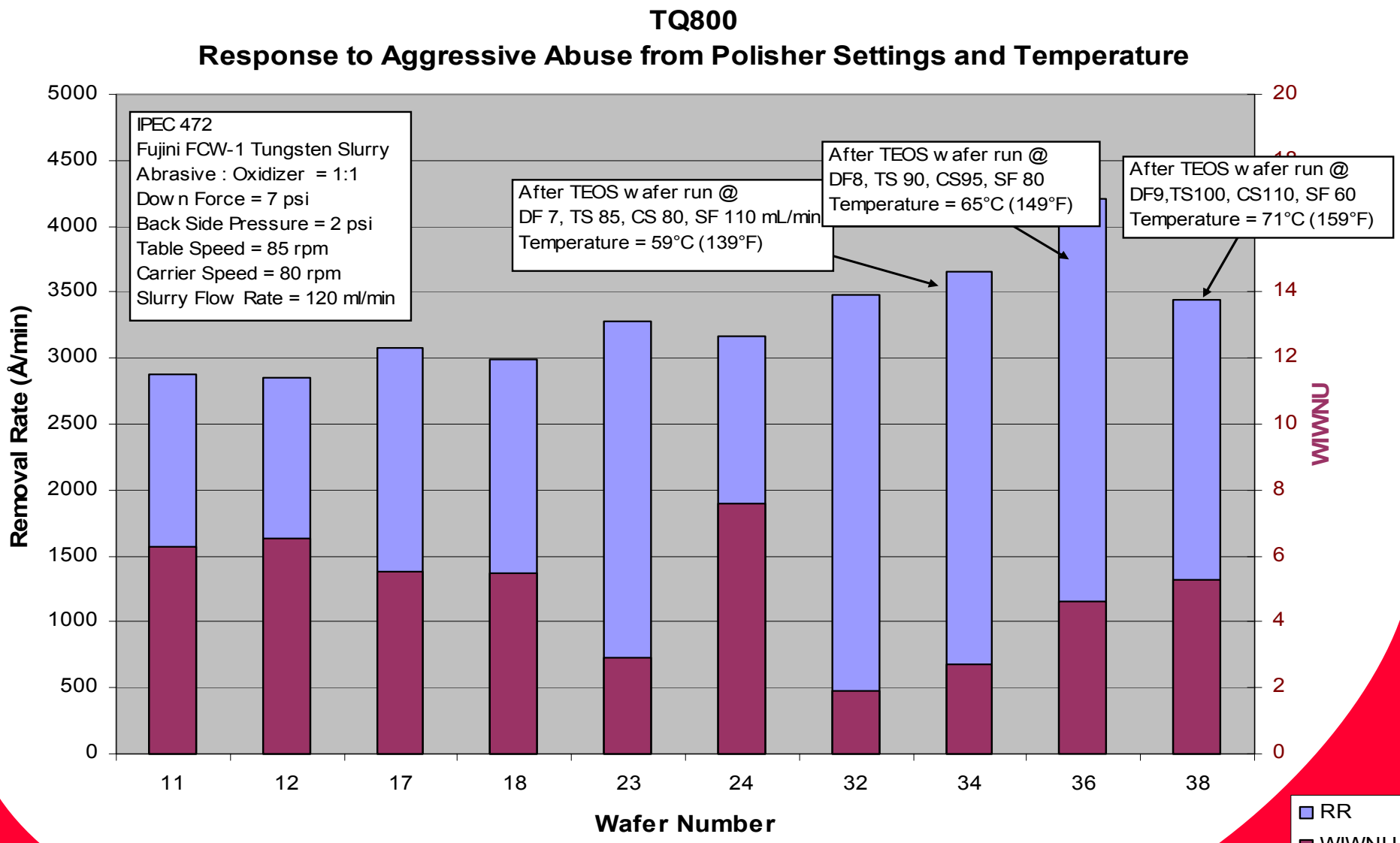
$[H_2O_2]$ and Slurry Dilution

- Increasing $[H_2O_2]$ can increase Removal Rate
- Works very well at higher $[H_2O_2]$
  4% H_2O_2 vs. typical 2%
- No increase in keyholing (coring)

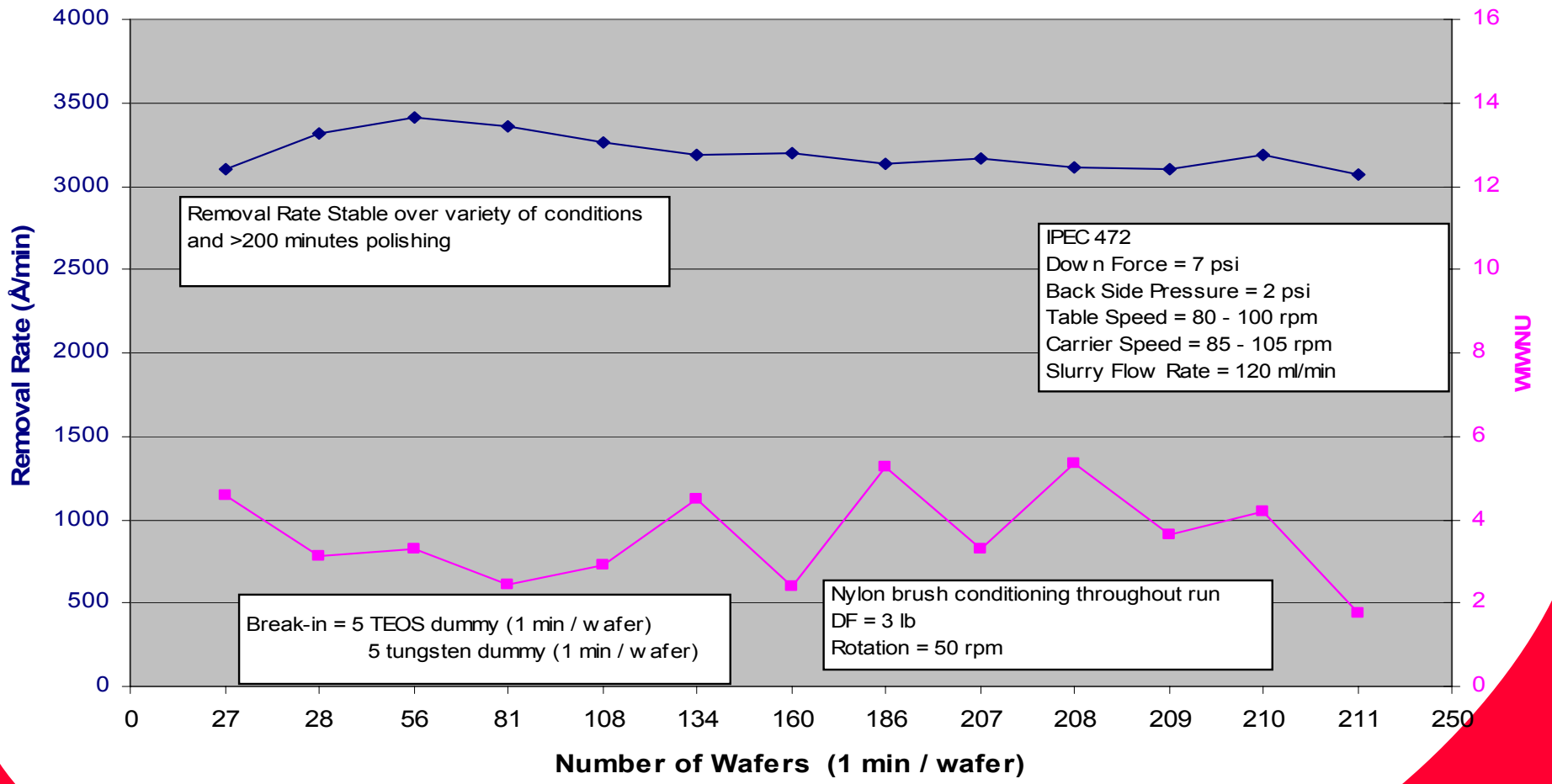
- Increasing slurry dilution can decrease Cost of Ownership & environmental cost

- Works well with non-H_2O_2 slurry

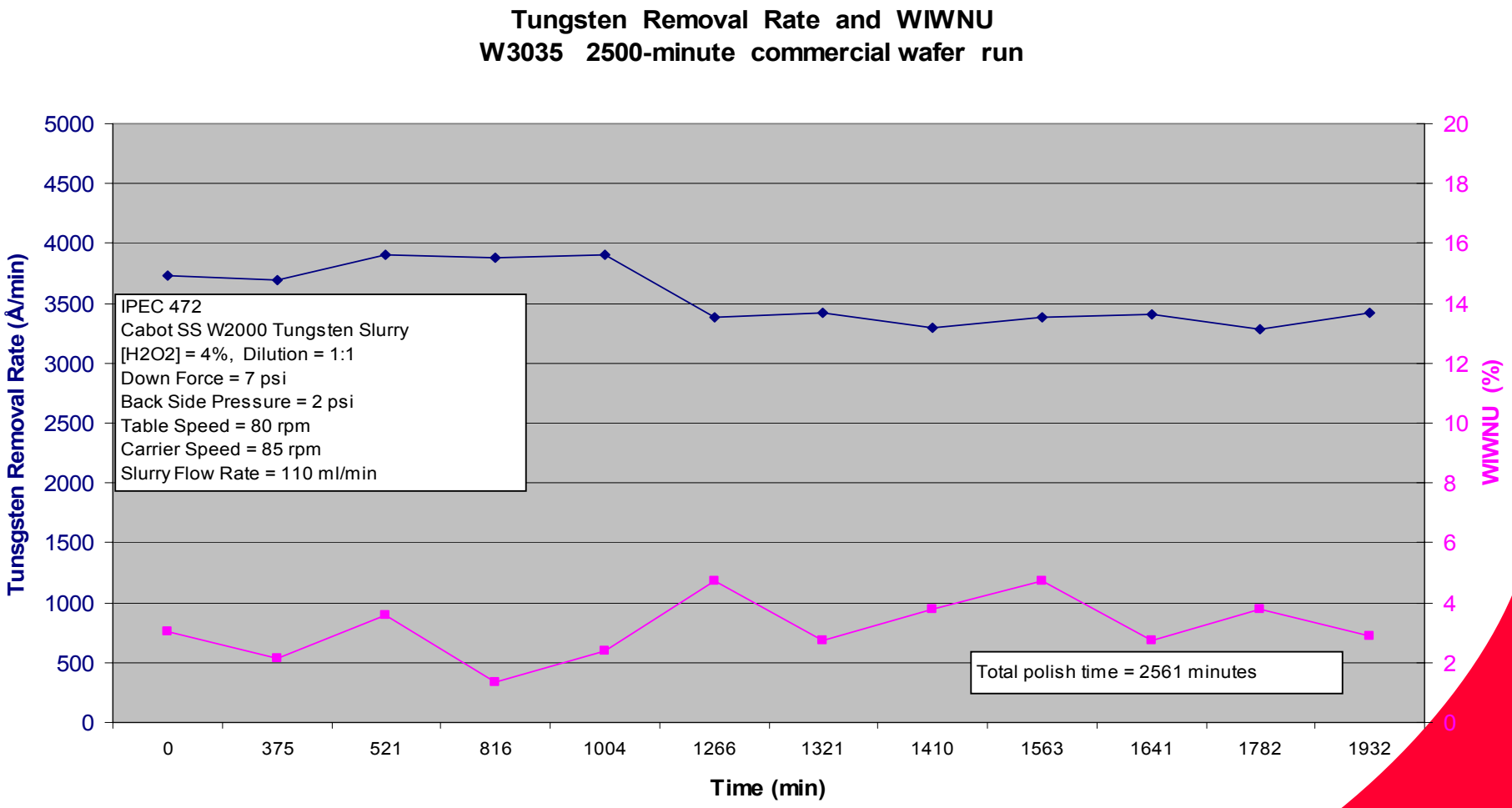
TQ800 Evaluation



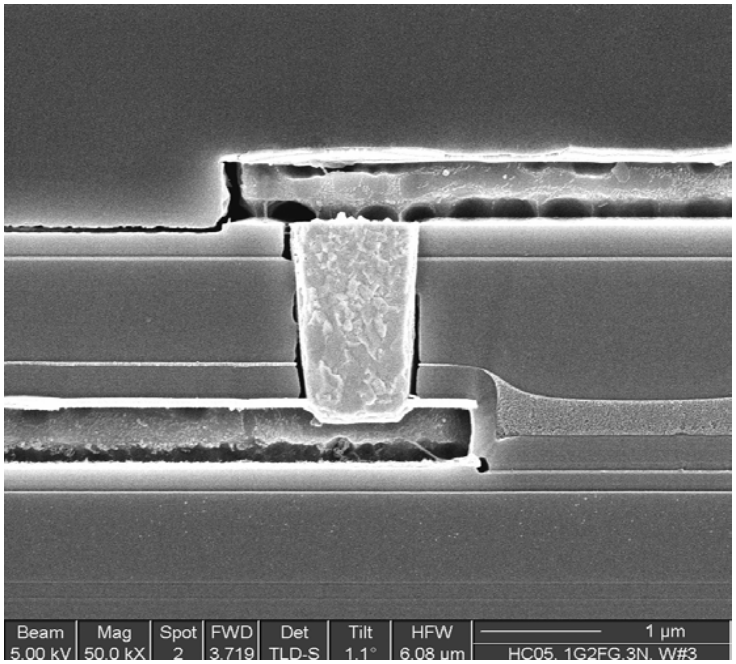
W3870 Evaluation



Tungsten Removal Rate and WIWNU
W3035 2500-minute Marathon



Cross section of completed via Commercial wafer



- Excellent plug planarity and controlled recess.
- End-of-line device yield equivalent between outsourced CMP and existing qualified fab process.

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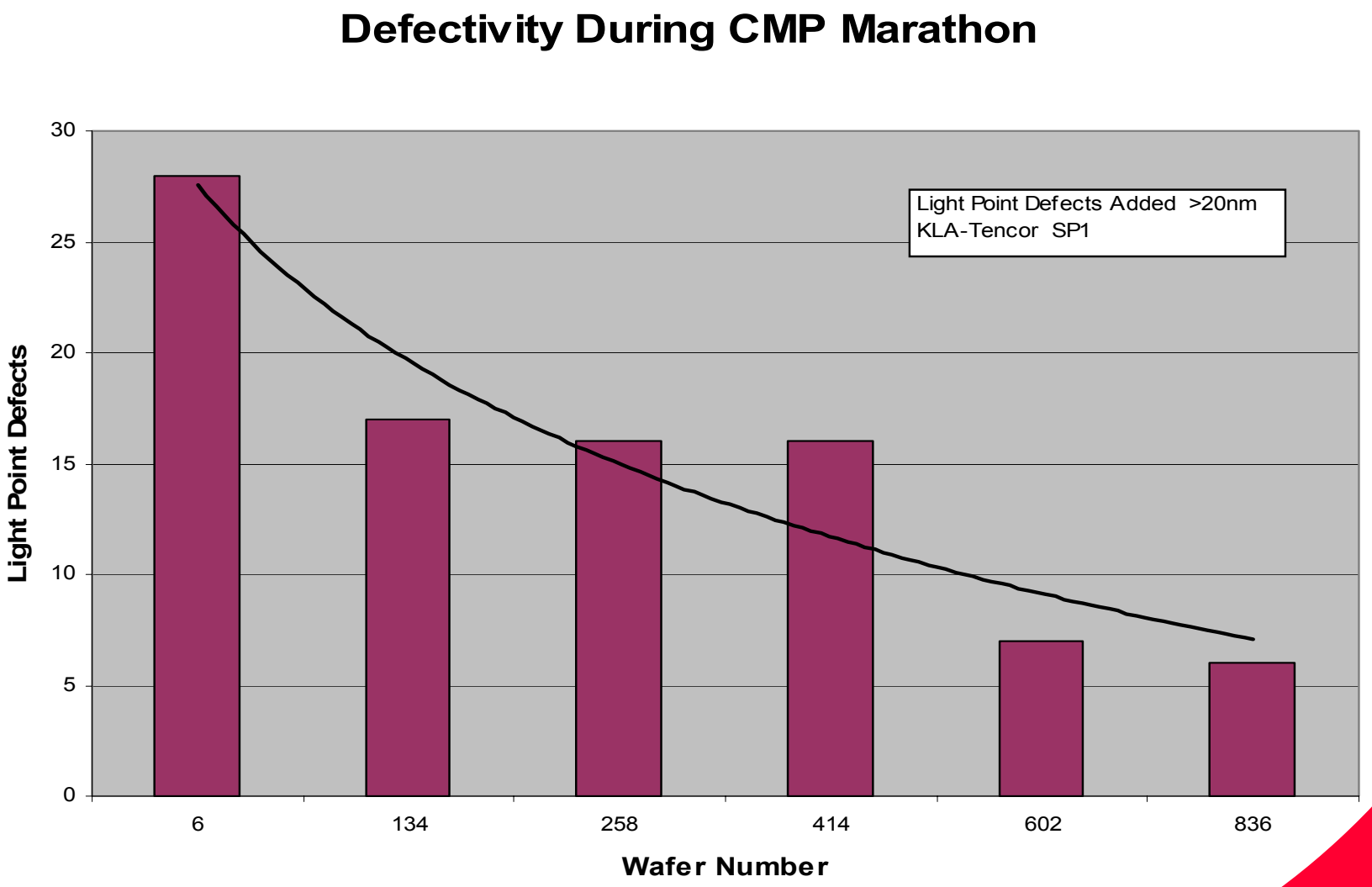
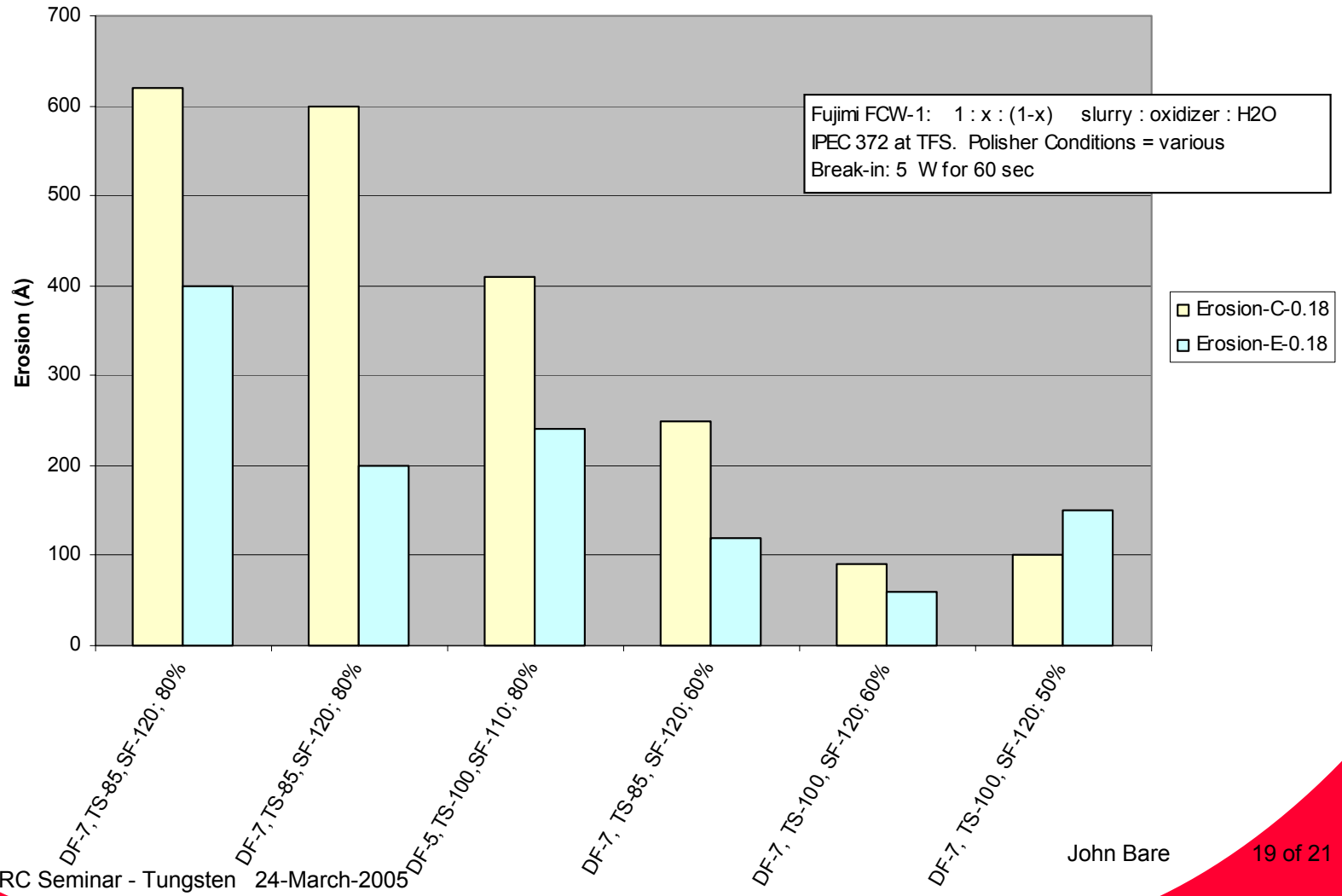
Defects



Erosion with Fujimi slurry

Tungsten Polishing Pad Erosion Evaluation for 50 mil pad thickness
Oxide Erosion as f(DF[7 & 5], TS[85 & 100], Oxidizer[80%, 60%, 50%])



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Material Properties of Interest

Overall performance results from convergence of several parameters/properties

- Material
  - Some properties determined by composition of polymer material
  - Some properties determined by manufacturing process
- Cell Size
  - Typical cell size ~ 100 - 200 microns
  - Smaller cell size gives more, smaller land areas for pad-wafer contact
- Hardness
  - Hardness is f(density for similar starting material)
  - For given material, harder = denser = more land area
- Thermal Stability
  - Higher thermal stability improves lifetime
  - PE gives more thermal stability than EVA
- Additives/Filler
  - Increase effective hardness of pad for a given material
  - Change asperity size and distribution
  - Change Coefficient of Friction

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Summary
Tungsten
CMP Polishing Pads

- polyolefin pads – alternative to polyurethane
- Balance of performance properties
  - RR, WIWNU, Dishing, Erosion, Defects
- Low Cost of Ownership
  - ➢ No diamond conditioning
  - ➢ Long pad life
  - ➢ Lower slurry consumption