DISCOVER

knowledge • experience • innovation • partnership

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Perfecting the Surfaces of Tomorrow™

Epic™

Epic™ Soft Pads

Cabot Microelectronics Approach

March 2014

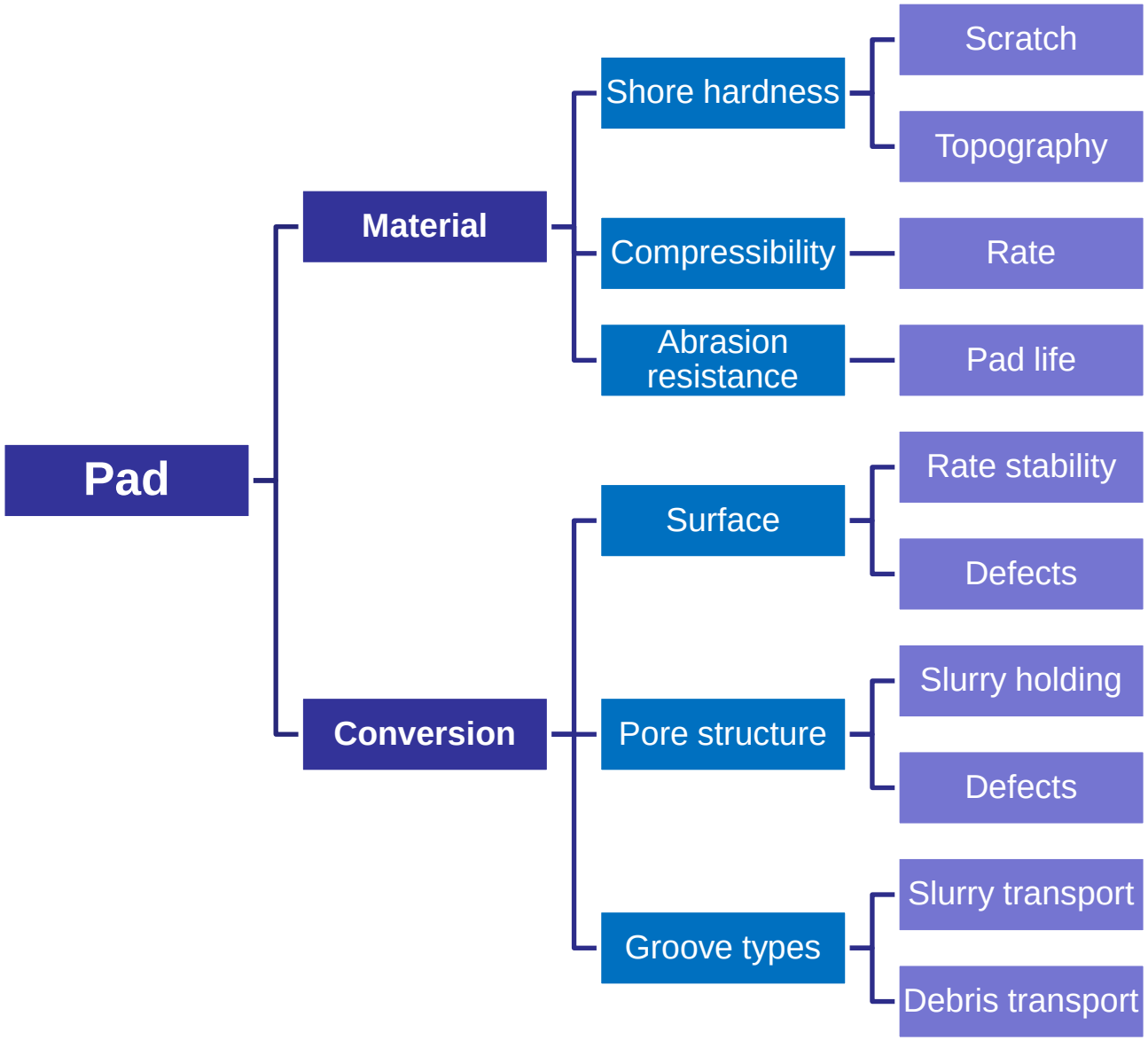
Outline

- **Need of soft pads**
  - Driving force – defects
- **Challenges of soft pads**
  - Usable pad life
  - Process stability – rate, selectivity, topography
  - Batch to batch variation
- **CMC approach to soft pads**
  - Why thermoplastic pads?
  - Manufacturing technology advantage
- **Pads for barrier application**
  - Test results for pad stability and defects

Why Soft Pads?

- **Defects: Particle and scratches**
  - Slurry: complex designs to control selectivity for topography
    - New designs, new materials, new requirements
    - Pad first or slurry first – difficult choice
  - Pad should be capable to remove residue and avoid scratch
    - Challenge is how to achieve integration requirement while maintaining low defects
- **Process knobs for pads**
  - Shore hardness – measure of resistance to indentation
    - Softer material leads to lower defects, but poor topography
  - Material hardness – resilience, modulus
    - Higher resilience and lower modulus helps lower defects
  - Pore structure – slurry holding capability, compressibility
    - Higher slurry holding capability leads to lower particle and scratch defects
  - Abrasion resistance – pad life
    - Pad life should be similar to hard pad/bulk polish step

Pad Design Concepts



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Why Thermoplastic?

- **Thermoset vs. Thermoplastic**
  - For soft material, differences of TPU vs. TSU are small – cross linking absent in both cases
  - No metal contamination, or additives in thermoplastic material
  - $(\text{Isocyanate})_{1\ \text{mole}}$ + $(\text{diol + Polyol})_{1\ \text{mole}}$ ➔ polyurethane
    - Tight stoichiometry control of components will lead to non-cross linked TPU
  - Hydrolysis resistant, low abrasion
- **CMC Foaming Technology**
  - Non-chemical blowing agent technology
  - Solid State Foaming
    - CO_2 saturated sheet is removed and is exposed to foaming conditions (above Tg)
    - Microcellular structure is formed as a result of system responding to CO_2 escape (nucleation and growth)

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CMC Pads Portfolio

Toolinc.com

Good Defectivity

Porosity	25D	42D	50D	60D	72D
Very High (>60%)		*F99*		*F66*	*F33*
High (40-50%)	*F12*	*F9*	*F8*	*F6*	*F3*
Medium (20%-40%)			*F7*	*F5*	*F2*
Low (<20%)	*F11*	*F10*		*F4*	*F1 / D100*

Good PE

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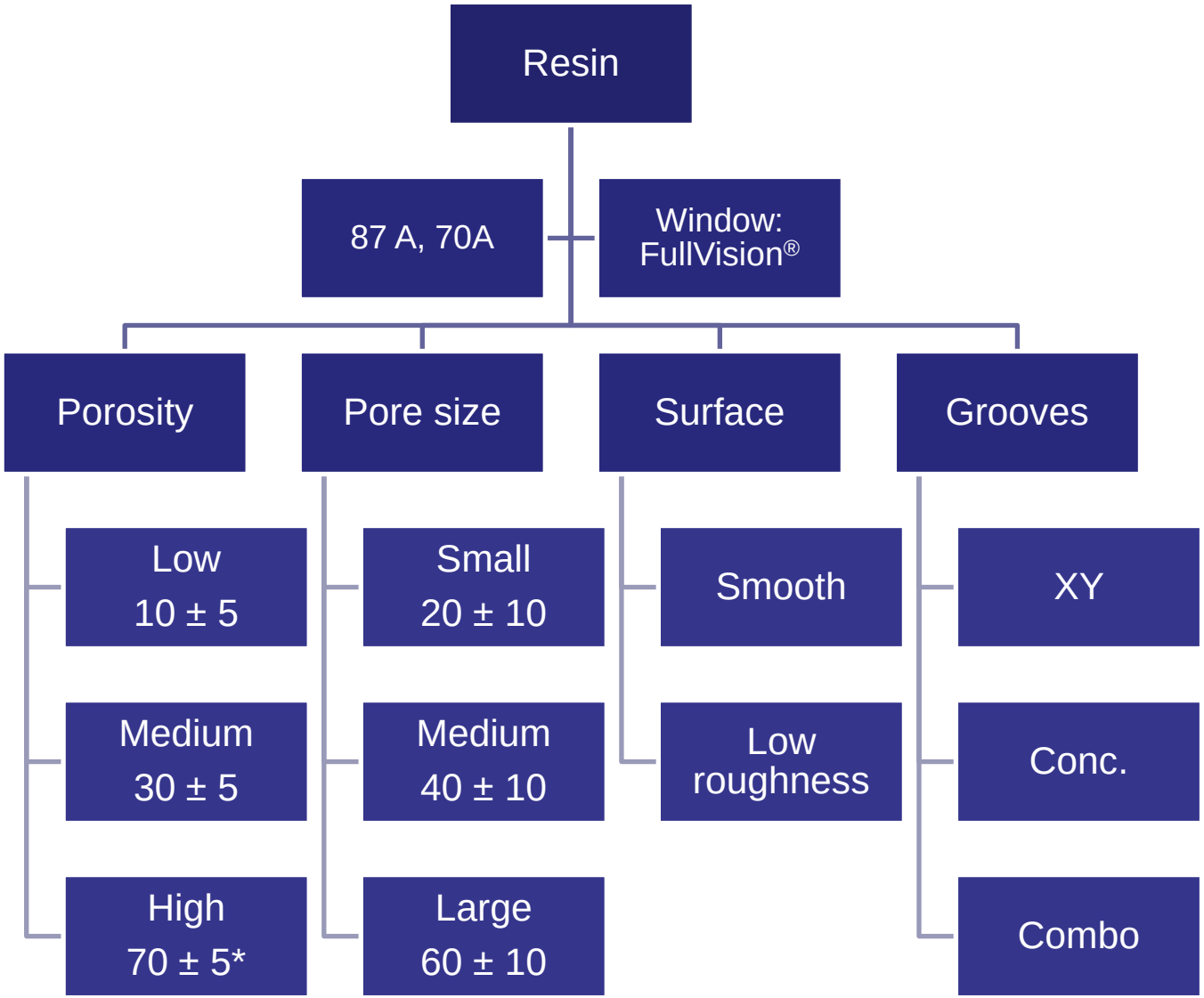
CMC Soft Pad Portfolio



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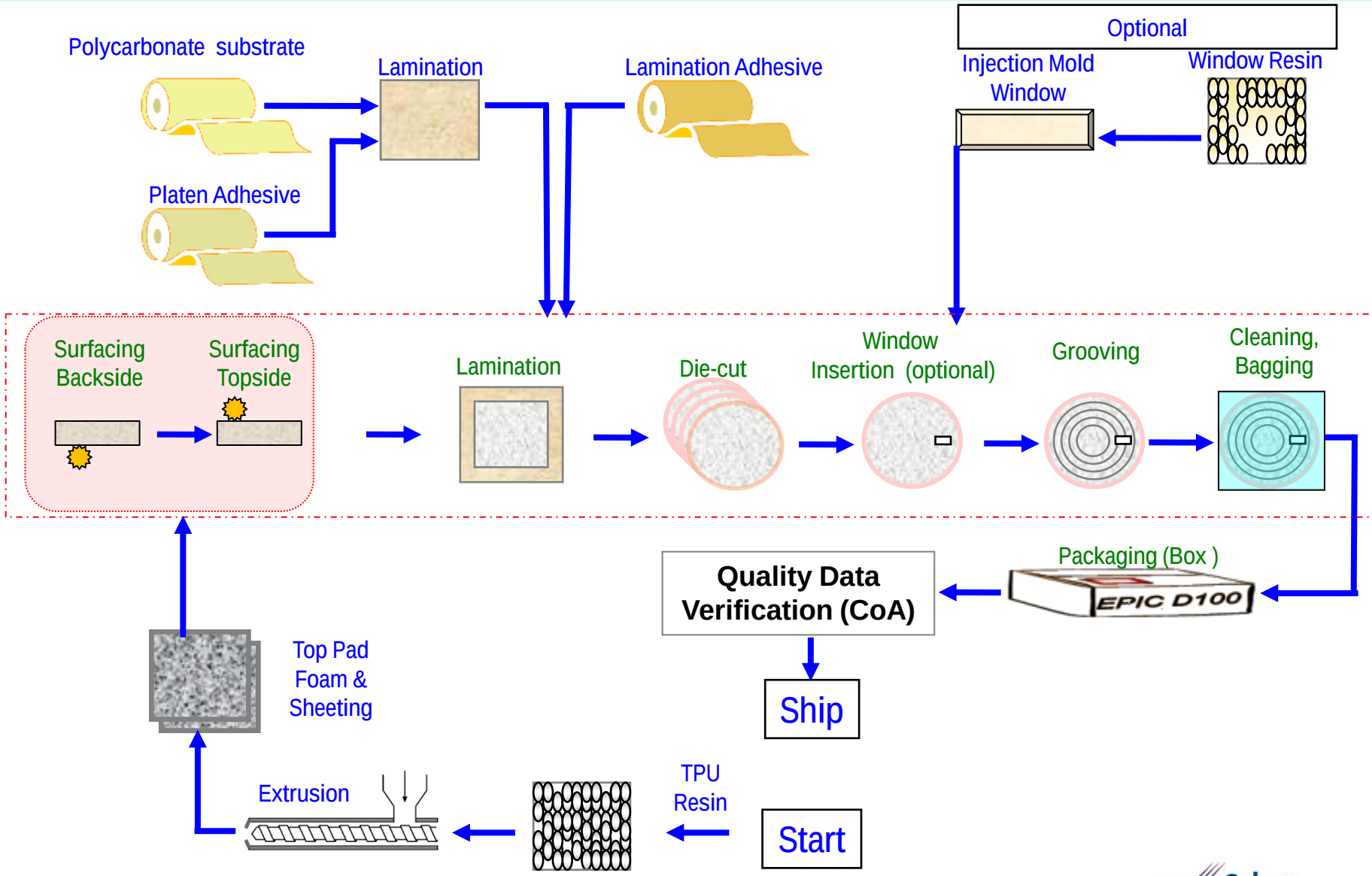
D2xx Process Flow



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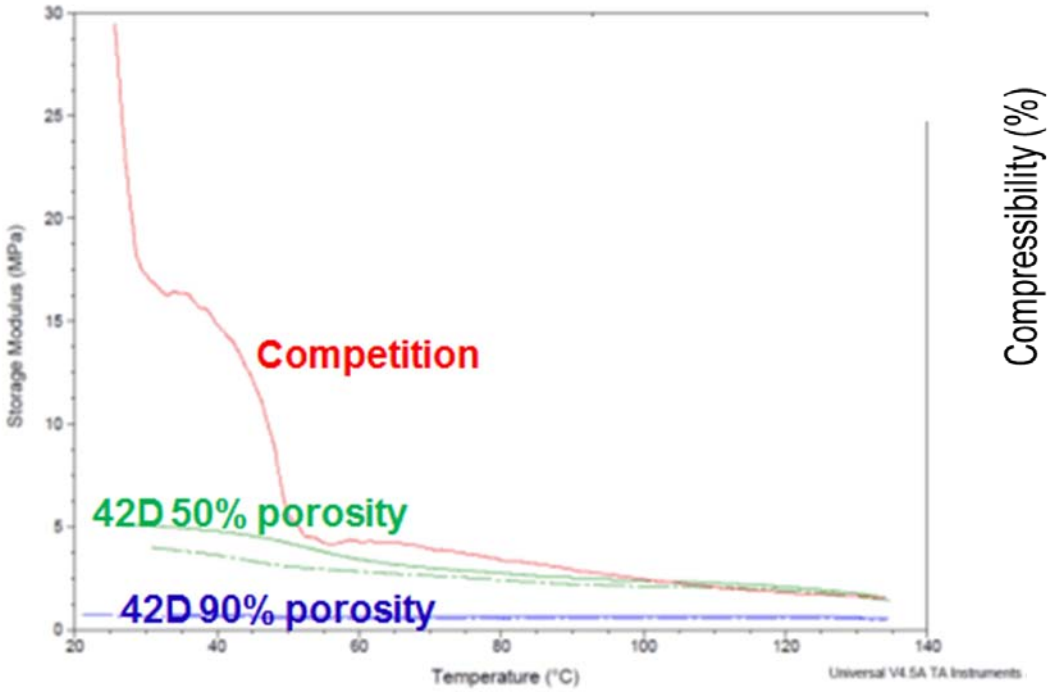
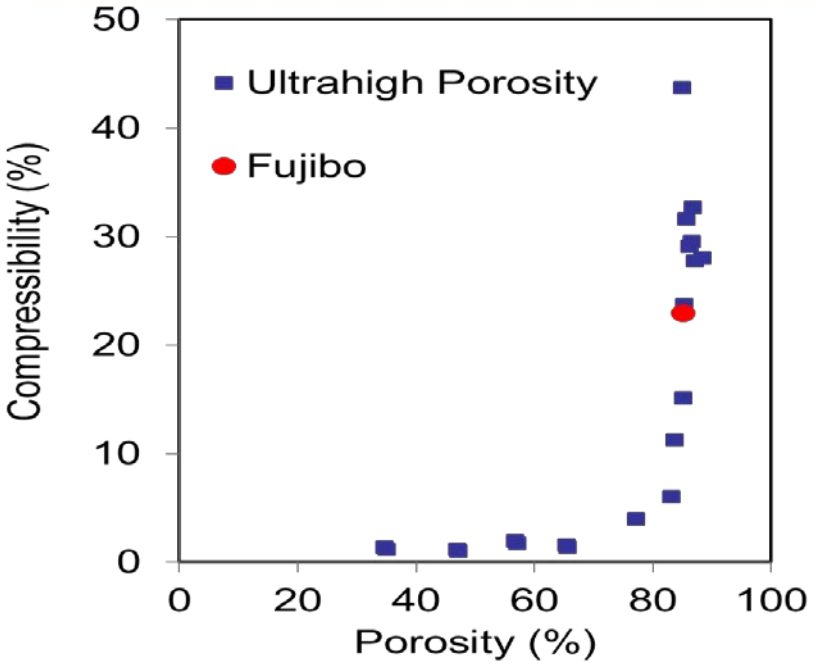
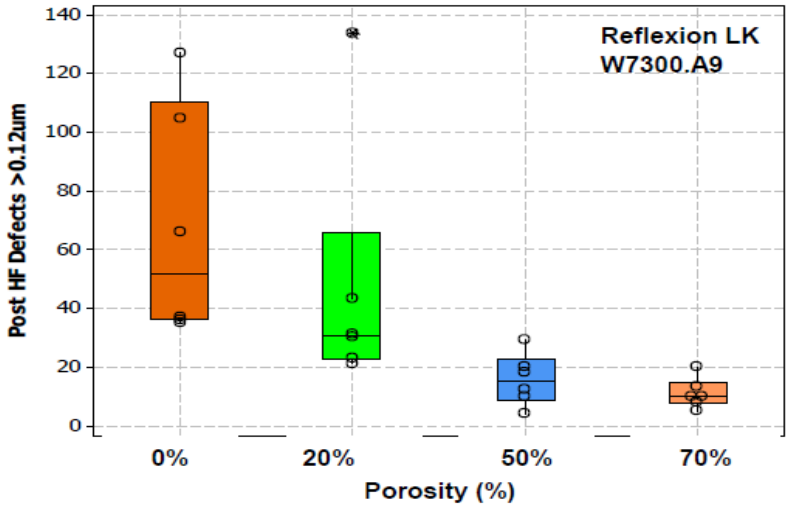
Defectivity vs. Porosity

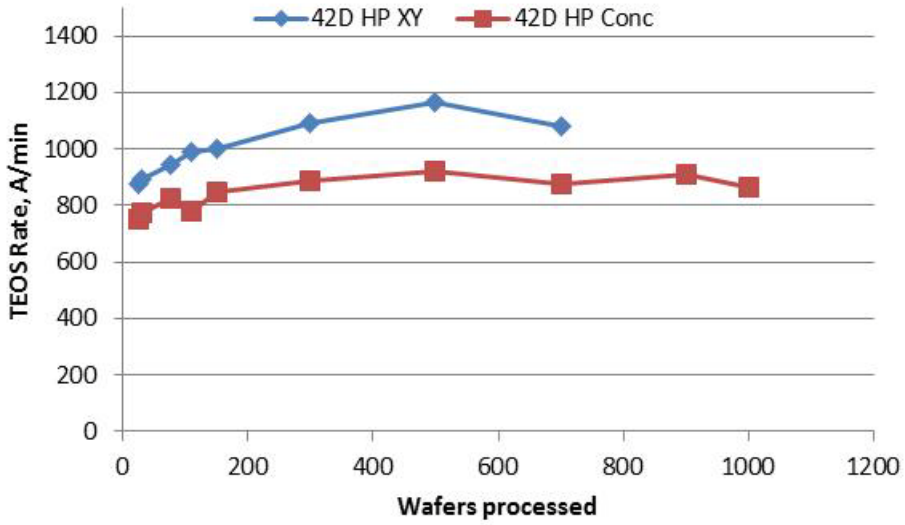


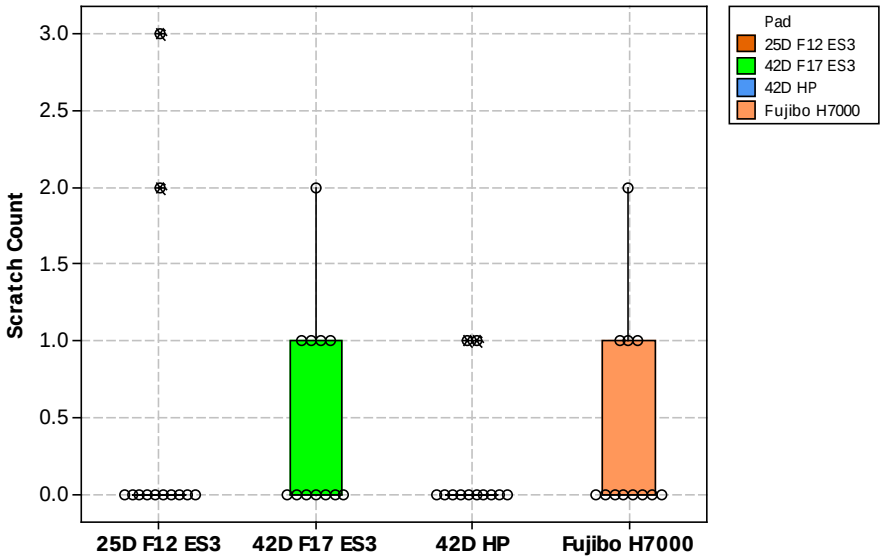


- Higher porosity pad has lower storage modulus and higher compressibility.
  - Better defects, higher rate



Polishing Rate Stability





- High porosity pads lead to high rate and lower defects
  - Ideal candidate for barrier process
  - Stable and long pad life

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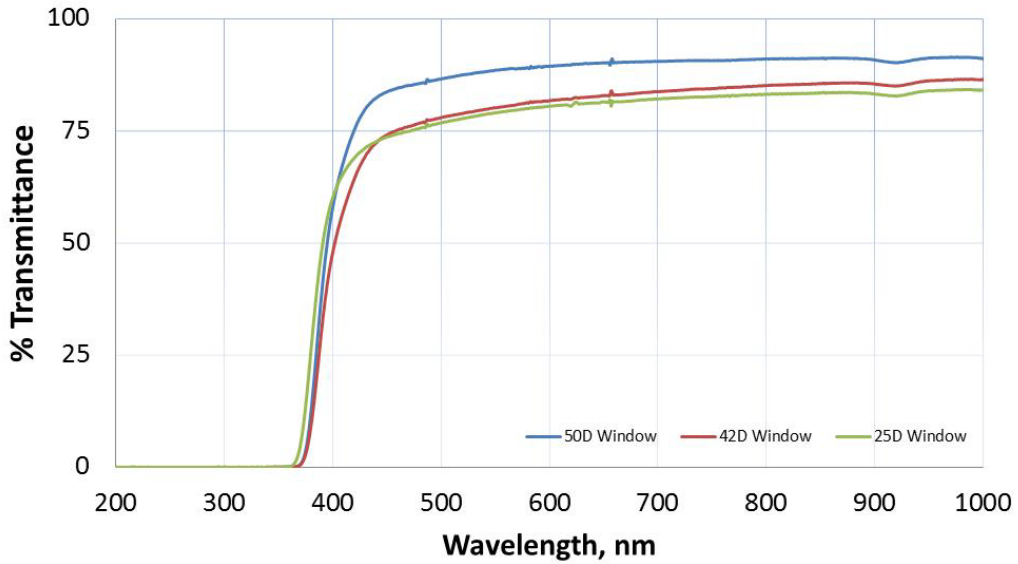
FullVision™* Window

- Window Technology
  - Unique window installation technology – TPU advantage
  - Welded windows, 100% leak tested
  - Capable to match pad resin hardness with FV window
  - UV stabilized material to ensure stable performance over pad life
  - Window hardness – match to pad resin hardness



*Trademark of Applied Materials, Inc.

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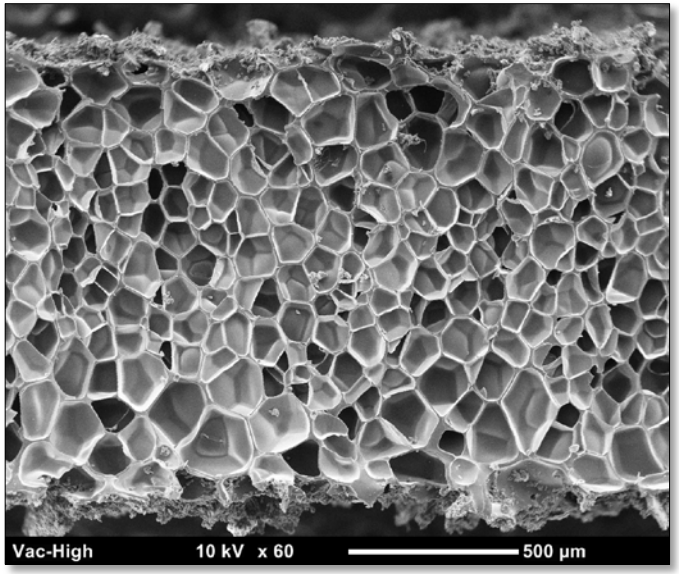
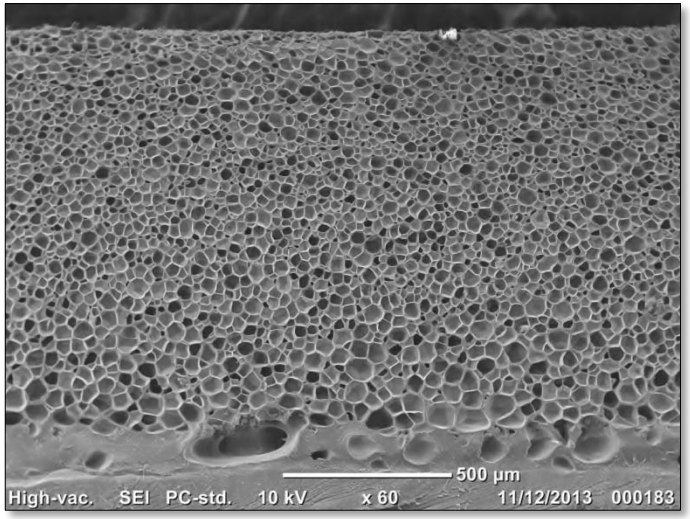
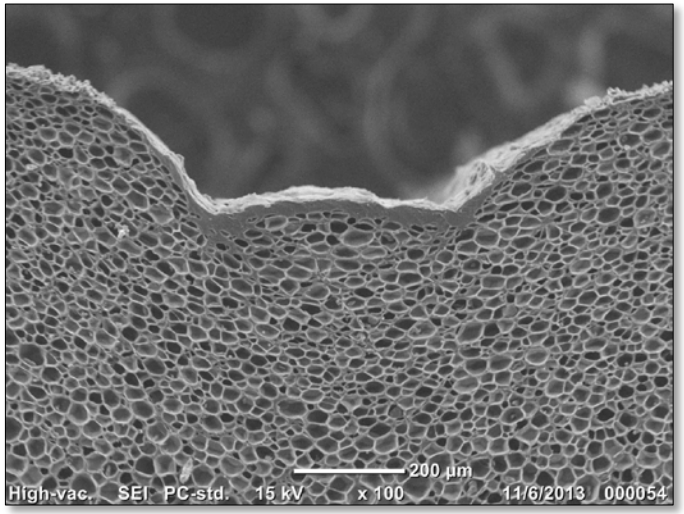
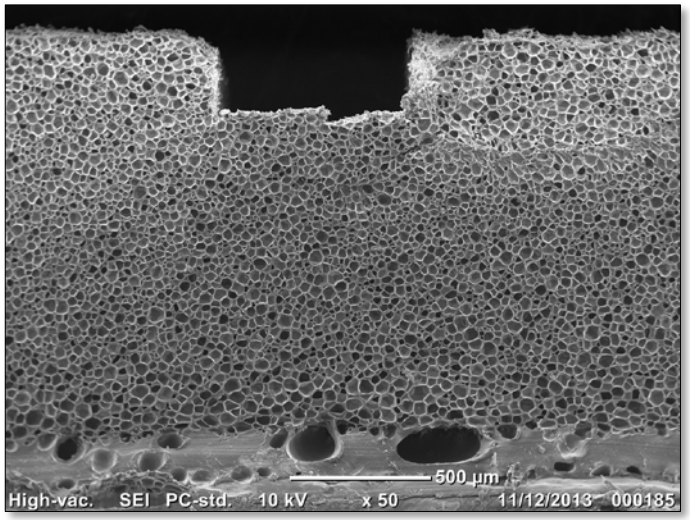
D200 42D HP XSEM









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Thank You