

# Development of a New Tungsten Pad Utilizing Outsource CMP Capabilities

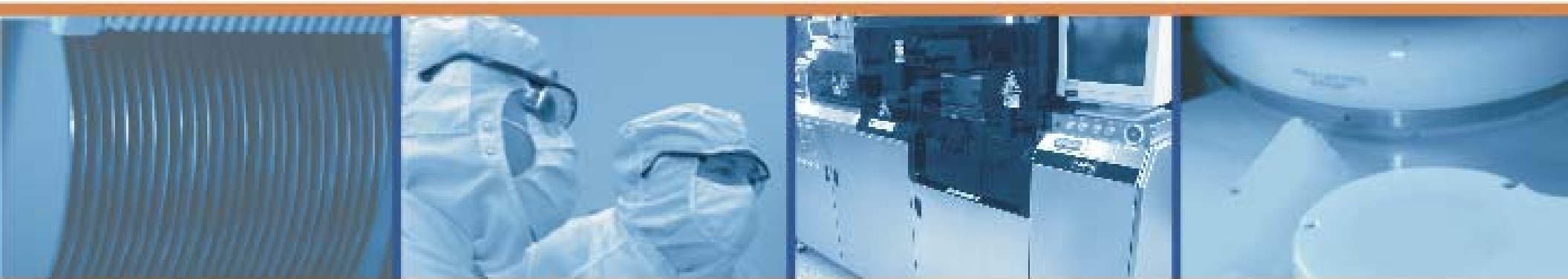
by

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**This paper describes a viable approach to rapid cost-effective development of advanced CMP consumables, specifically a tungsten CMP polishing pad, utilizing an outsource CMP foundry to generate virtually all wafer-level data. From screening of initial materials through final process optimization and marathon runs, the availability of a fully capable outsource CMP provider allowed the project to proceed faster and at lower overall cost than could have been achieved with only internal resources.**

**NOTE: Entrepix provides wafer-level testing and other development support services to psiloQuest on a work-for-hire basis. No other type of partnership or distribution arrangement exists between the two companies. Any inquiries regarding psiloQuest products (pricing, availability, performance, etc.) must be directed to psiloQuest.**

## Expertise:

- Highly trained and experienced technical staff
- Understanding of materials science, chemistry, tribology, and more
- Support staff for infrastructure, maintenance, etc.

## Equipment:

- Major capital investment
- Process tools: Polisher & Cleaner
- Metrology: film thickness, defect inspection, surface topography, etc.
- Ongoing expense to maintain

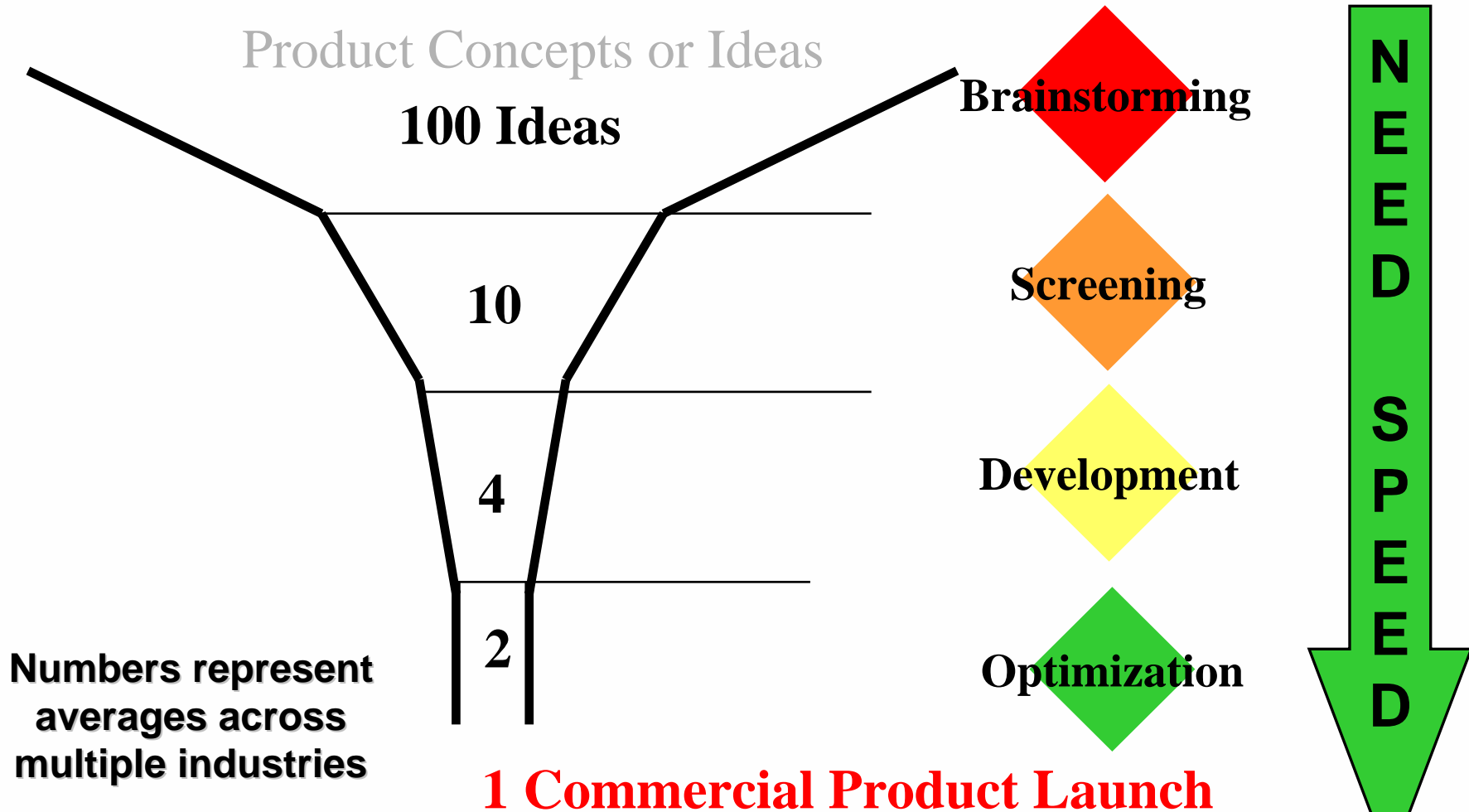
## Cleanroom:

- Minimum of Class 100, preferably Class 10 or Class 1
- Required support systems include: DI water, compressed air, waste water treatment, nitrogen, etc.
- Substantial overhead cost even when idle or unused

## Consumables and Test Wafers:

- New materials require new slurries
- Pad optimization can be difficult
- Requires in-depth expertise
- Access to large supply base is extremely helpful in early testing

# Typical Product Development Funnel



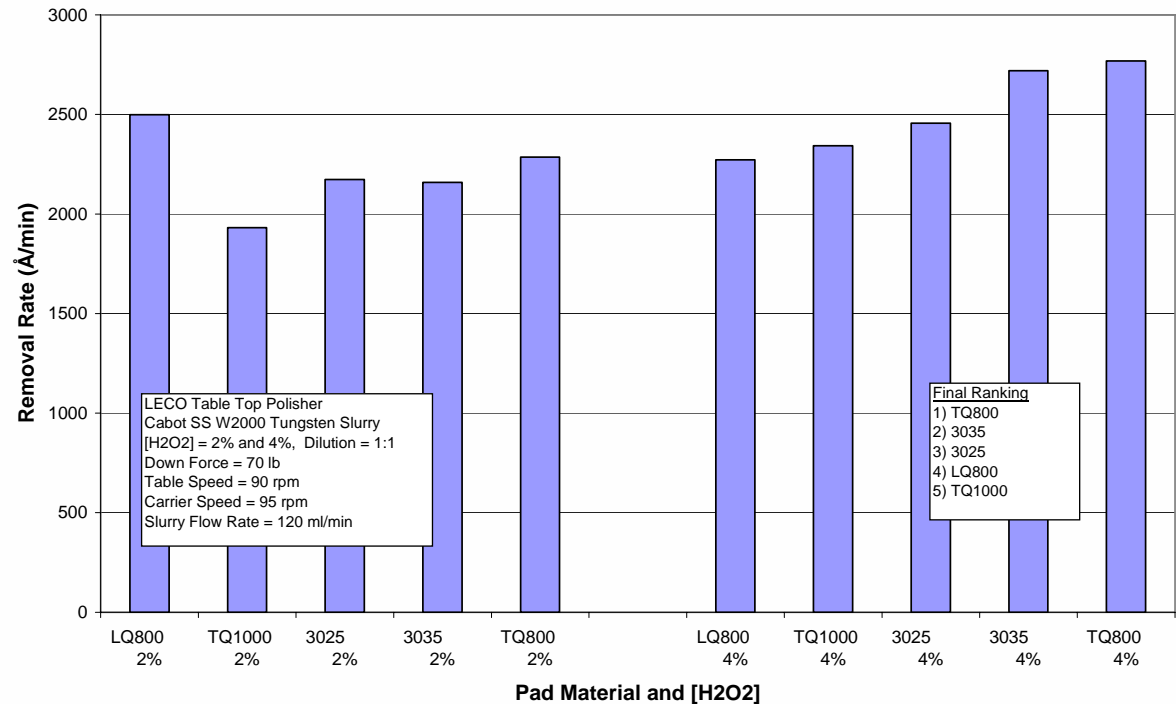
# Why Outsource CMP Development?

- **Faster Execution**
  - Tap into existing facility, equipment, and process technology
  - Reduce implementation time by 12 months or more
- **Lower Risk**
  - Leverage technical expertise and known baseline processes
- **Lower Cost**
  - Zero capital required
  - Low unit costs even for low to moderate volume production

A simple tabletop polisher and a standardized set of polishing conditions allows rapid, low-cost comparison of early formulations using small pad samples only 12" in diameter.

Only those pad materials that pass this early screening for rate and surface scratching are then made in larger format samples required for testing in the cleanroom on 200mm CMP tools.

LECO Screening of Pad Materials

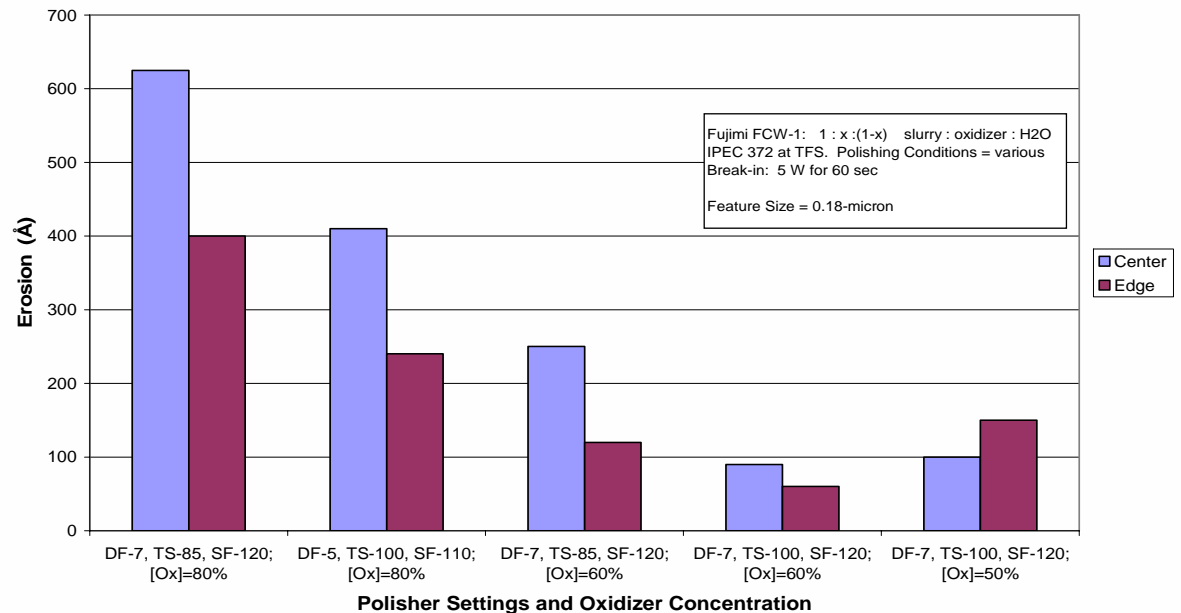


Once a small number of potential pad candidates were identified, wafer-level data was generated to assess performance compared to target values.

Typical wafer-level metrics:  
(some vary by material)

- Removal rate
- Within-wafer nonuniformity
- Wafer-to-wafer variation
- Dishing
- Erosion
- Field loss
- Defectivity
- Residual contamination

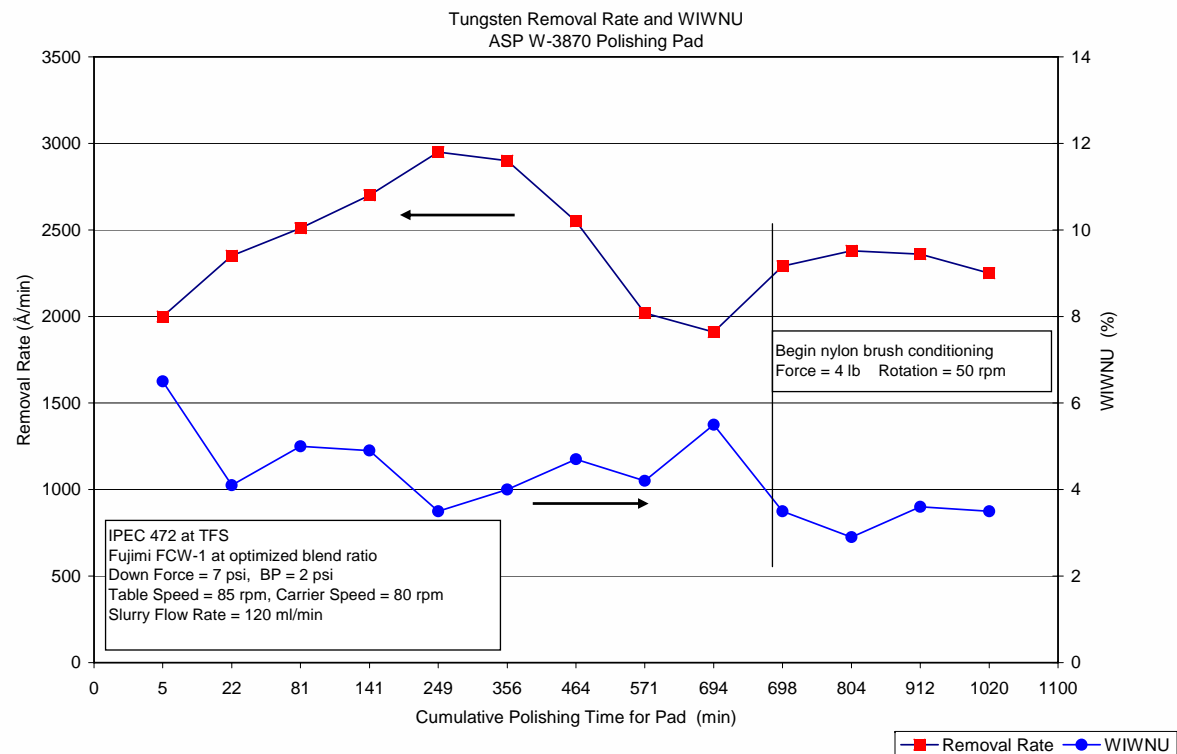
ASP W-3850 Tungsten Polishing Pad Erosion Evaluation  
Oxide Erosion as f(DF{7 & 5}), TS{85 & 100}, Oxidizer{80%, 60%, 50%})



The graph shown above is an example of patterned wafer data for erosion on a specific tungsten plug array. The target value of less than 150Ang erosion was achieved, and the dataset can be used to guide customers in their early process starting point decisions.

Consumables customers generally demand proof of process stability in a marathon run, which Entrepix can provide.

In this first attempt, a decrease in removal rate was observed after roughly 300 minutes of polishing. Process troubleshooting quickly led to a solution in the form of a gentle brush conditioner. The data clearly shows the desired recovery and subsequent runs are underway to prove long-term viability of this approach.



**Outsourced CMP on this specific pad development project accomplished the following:**

- 1. Simplified the customer's internal project team and leveraged the expertise of Entrepix as an the outsource CMP provider.**
- 2. Substantially shortened the project timeline.**
- 3. Provided access to fully capable process and metrology tools with zero capital outlay from the customer (psiloQuest).**
- 4. Generated an independent data package that can be shared openly at psiloQuest's discretion without violating any customer confidentiality agreements.**

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