Extending Probe Card Life for Fine Pitch Probe Cards

Gene Humphrey
International Test Solutions, Inc.
June 10, 2002

Southwest Test Workshop

9-12 June 2002

Long Beach, CA USA

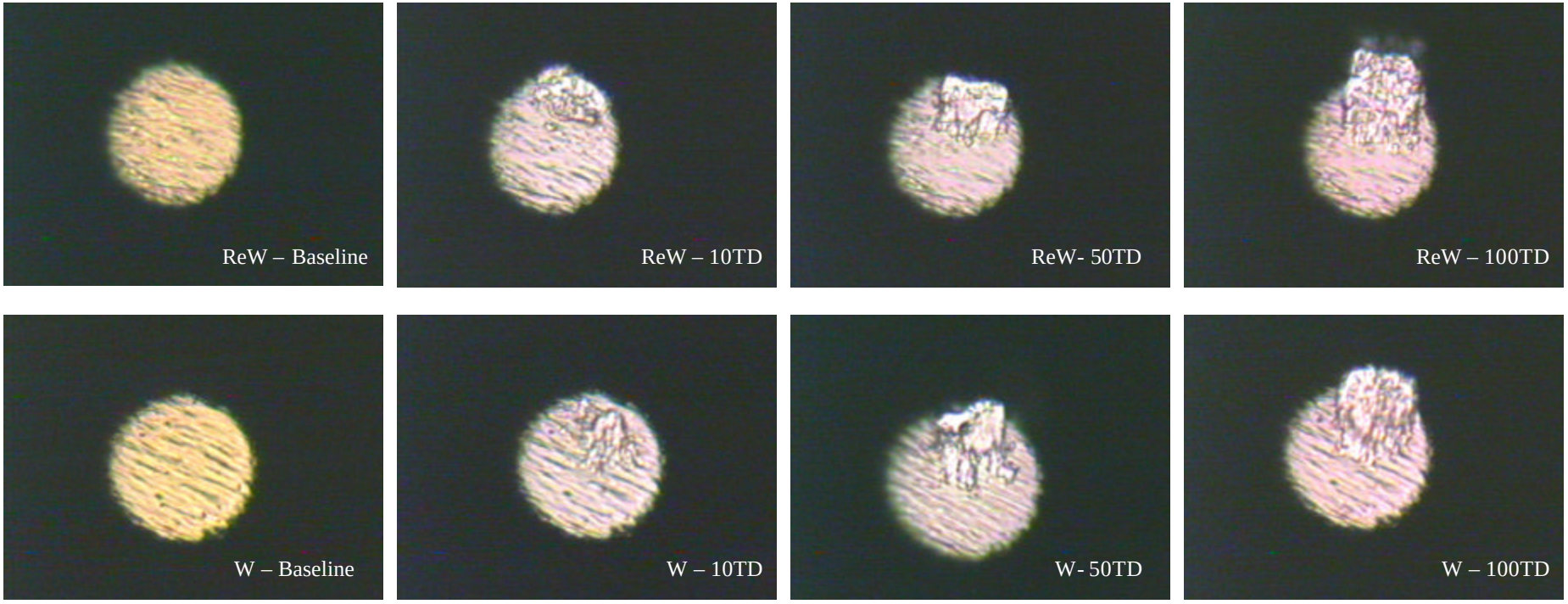
Material Considerations

- Relative Accumulation
  - Comparison of 5 Common Probe Materials
  - Effects of Probe Tip Roughness
- Effect of Cleaning Materials
  - Comparison of 4 Common Probe Materials
  - Comparison of 5 Common Cleaning Materials

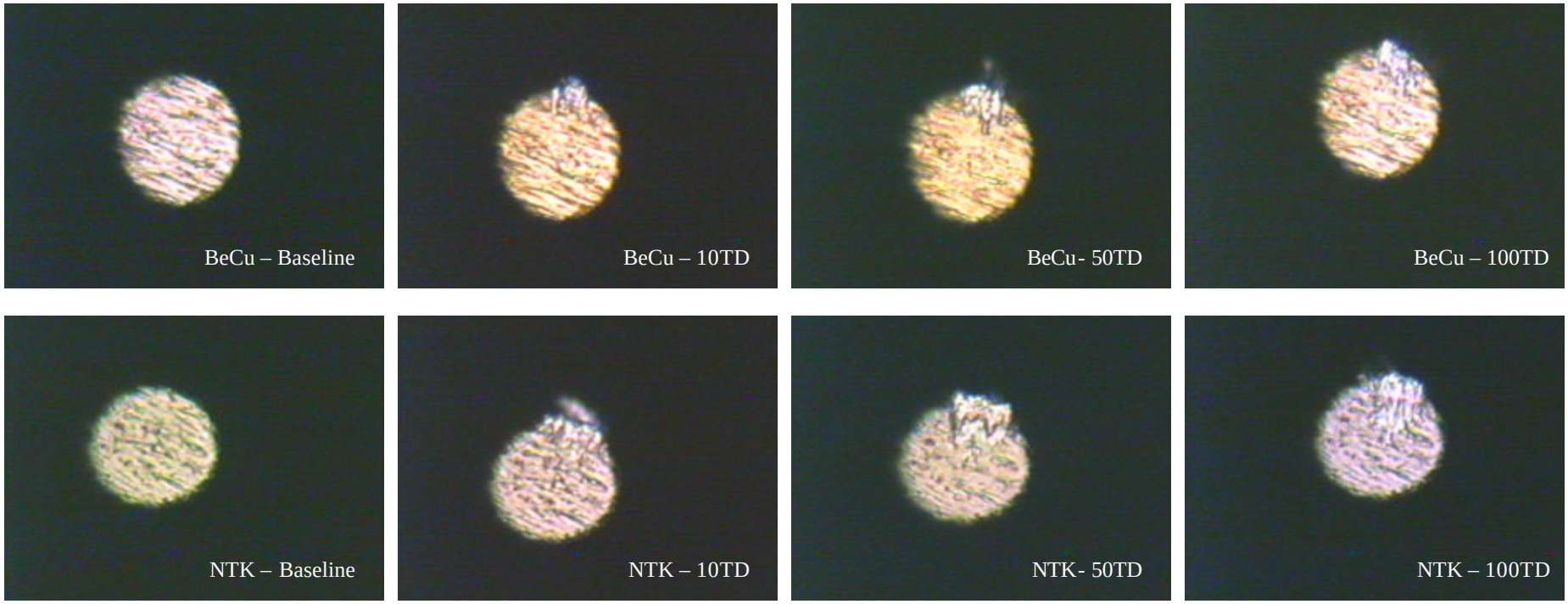
Accumulation Study

- 5 Probe Cards
  - One each of ReW, W, BeCu, P, NTK
  - Each Card with 10 Probes of the Same Material
  - Same Build Configuration
  - Study Conducted in Production Environment
    - No Electrical Testing
    - One Touch per die
    - 3 mil Overdrive
  - Same Test Condition for All Cards
  - No Cleaning

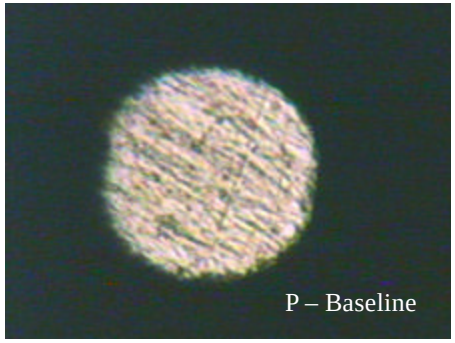
Probe 1 Comparison

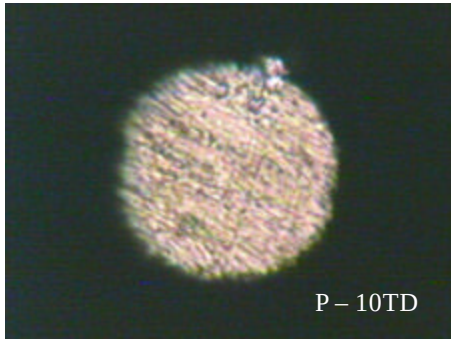


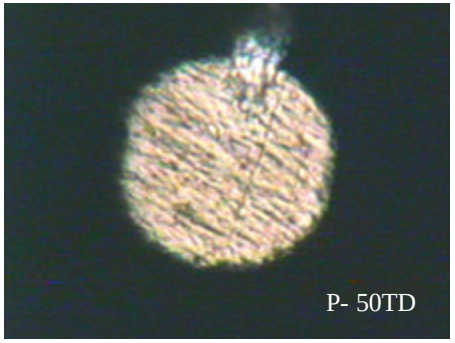
Comparison Probe 1

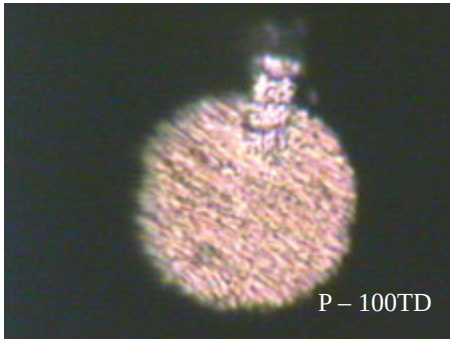


Probe 1 Comparison

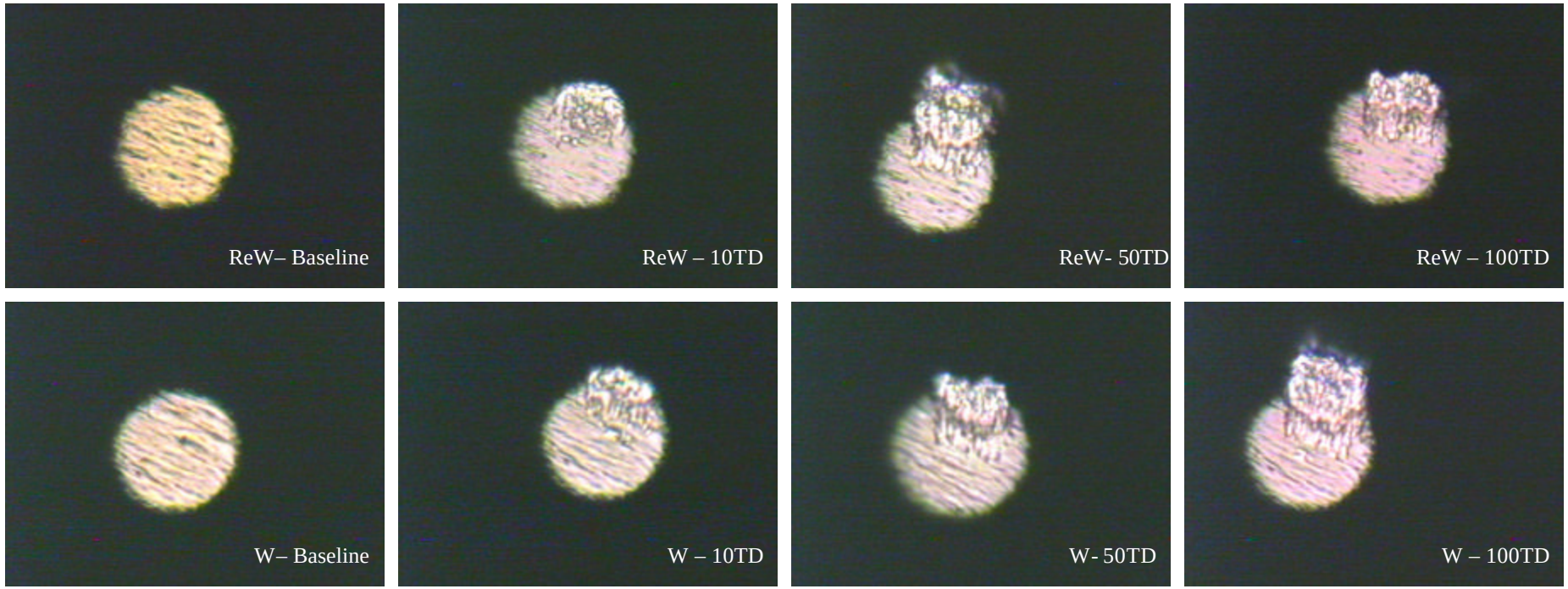




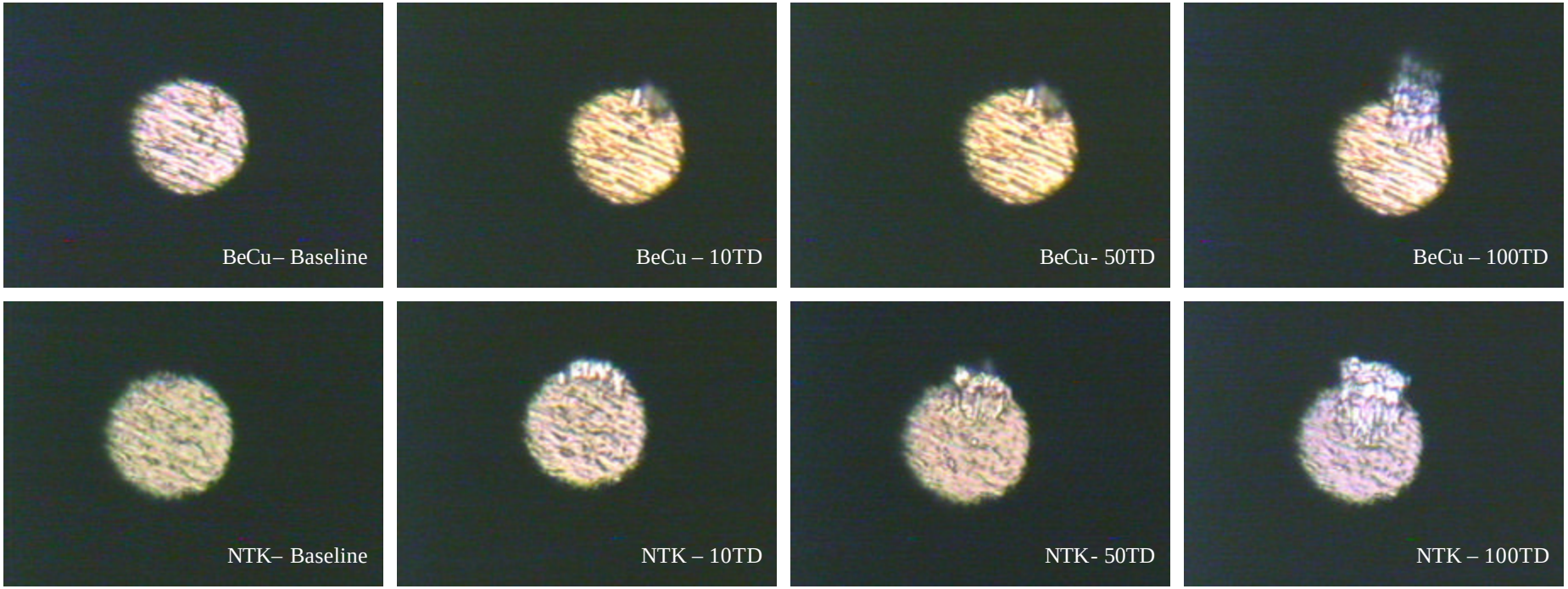




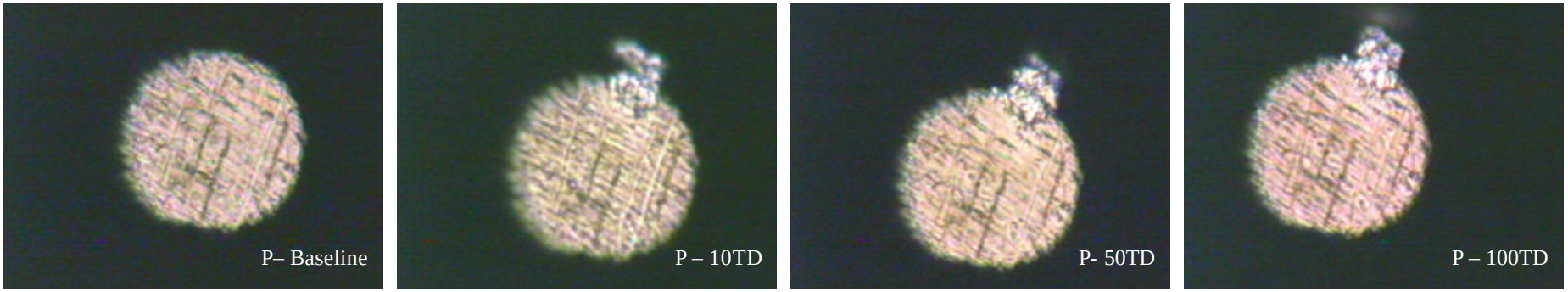
Probe 2 Comparison



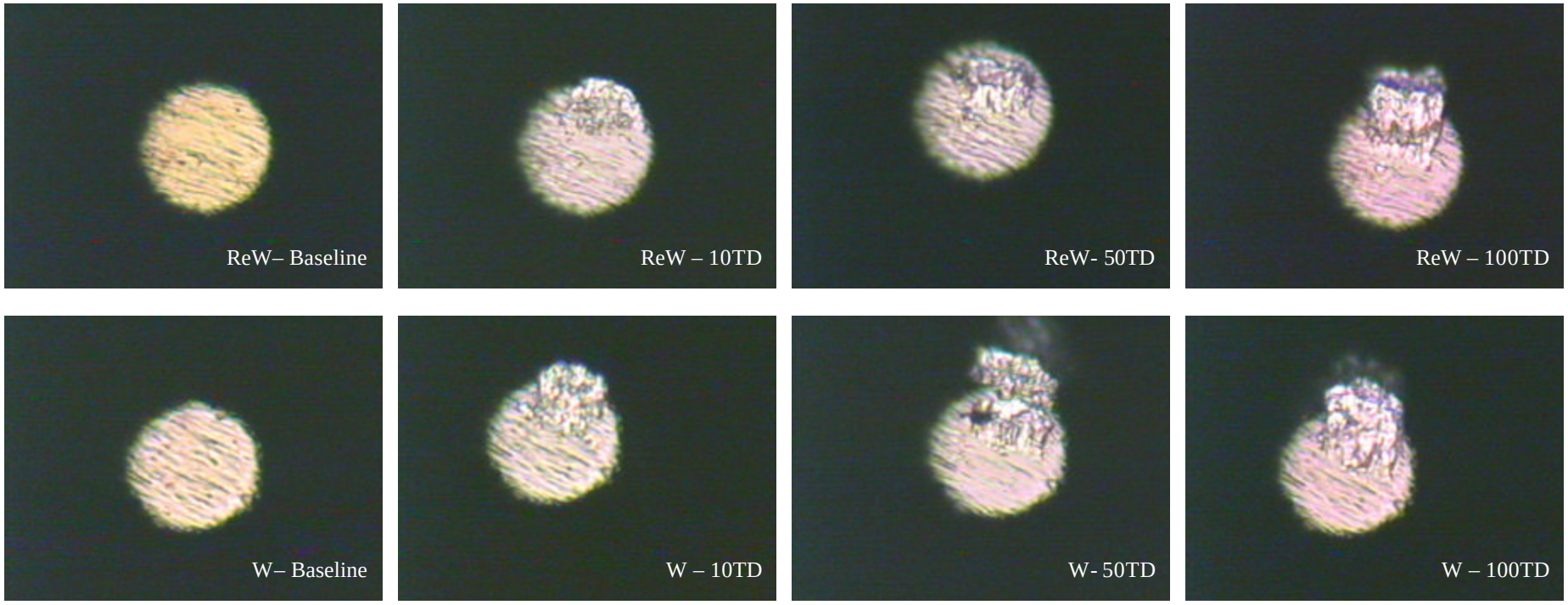
Probe 2 Comparison



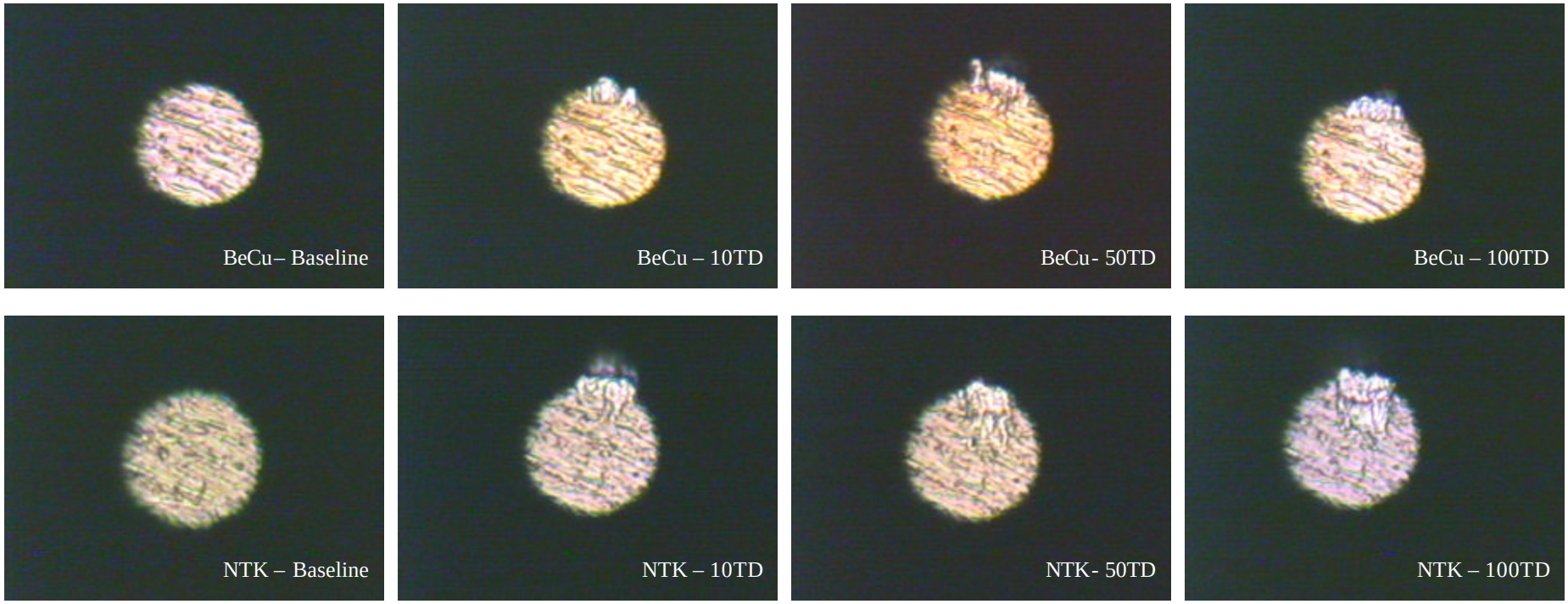
Probe 2 Comparison



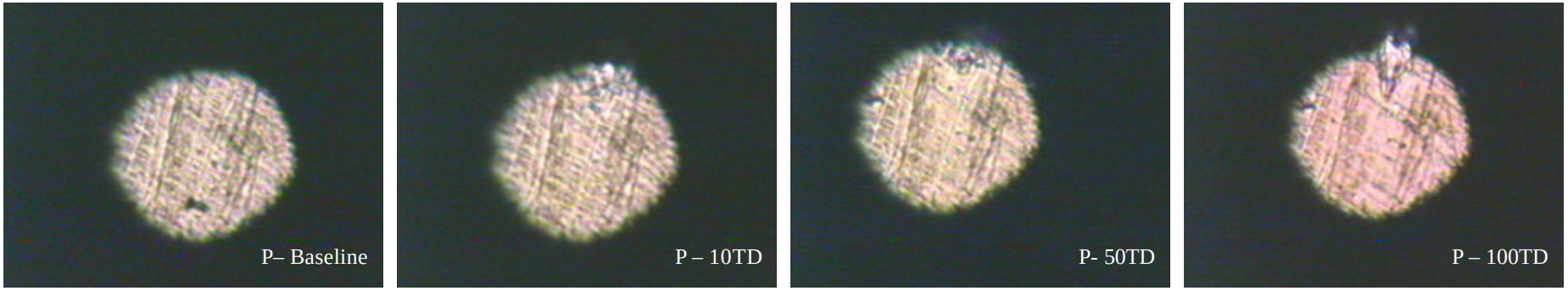
Probe 3 Comparison



Probe 3 Comparison



Probe 3 Comparison



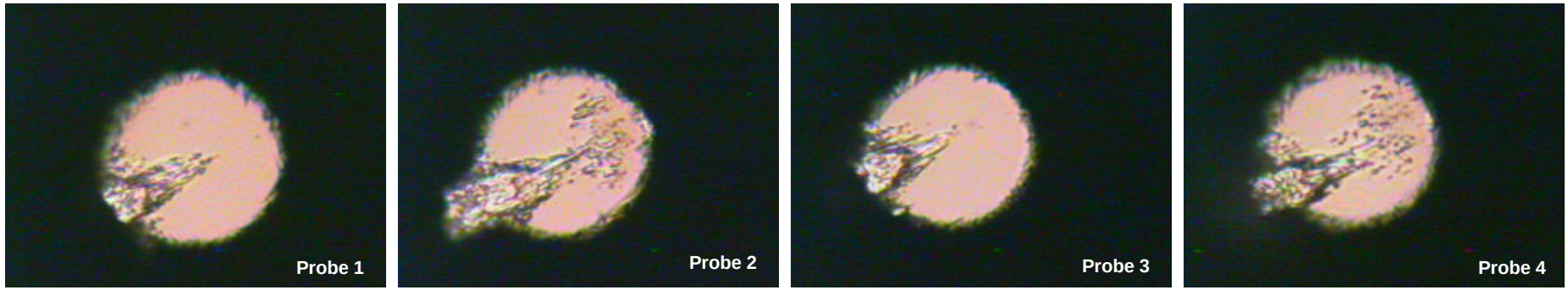
Accumulation Conclusions

- Relative Accumulation
  - ReW and W Accumulate at nearly the same rate
  - BeCu and NTK Accumulate at nearly the same rate
  - P Accumulation Rate Least of All Materials Studied
  - Substantial Difference in the Accumulation on ReW and P

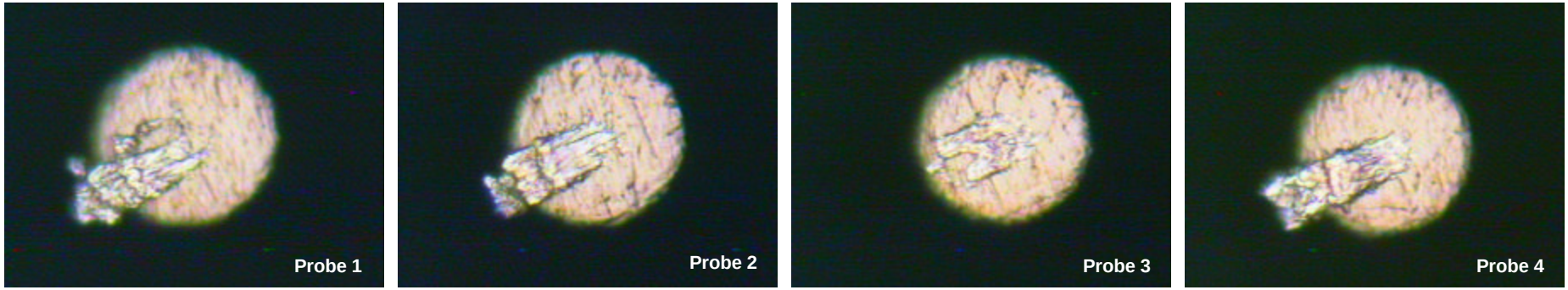
Effect of Roughness

- Does the Probe Roughness Effect Accumulation Rates?
  - One ReW Probe Card
    - 100 Touchdowns After Sanding Flat with 3µm Lapping Film
    - 100 Touchdowns After Sanding Flat with 0.5µm Lapping Film
    - No Electrical Testing

0.5 µm vs 3 µm



Probes sanded with 0.5µm AlO2 lapping film, 100TD



Probes sanded with 3µm AlO2 lapping film, 100TD

ReW Probes, same probes, same OD

Roughness Conclusion

- Appears That Roughness Does Effect the Rate of Accumulation of Material on the Probe Tips

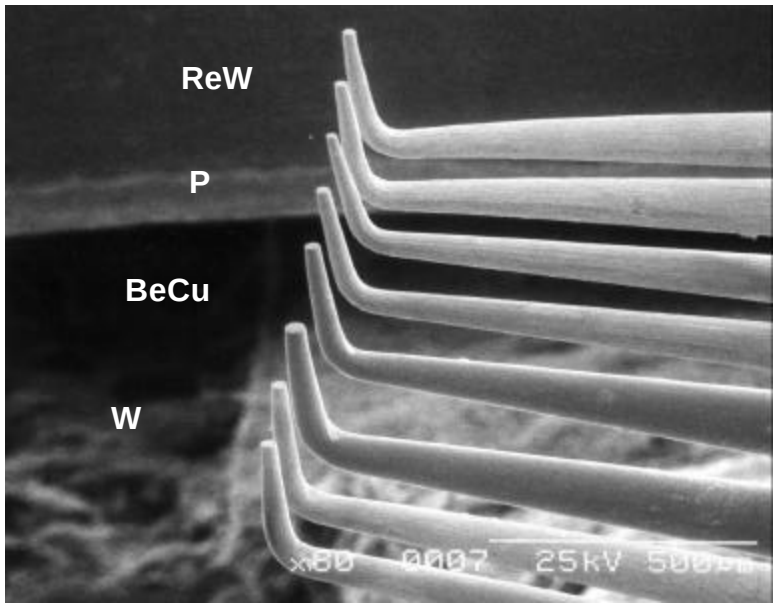
Durability Comparison

- “An Extremely Abrasive Analysis” Troy Harnish and Bill Wenholz, SWTW 2001

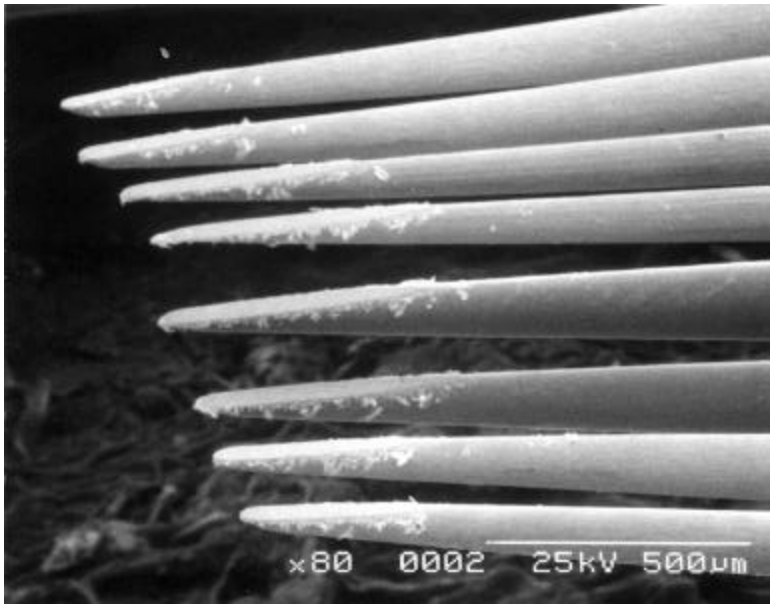
The Evaluation Basics

- Identical and simple probe cards
  - One probe card designated for each cleaning material
  - Cantilever design (epoxy ring)
  - Probe metallurgy and target size (flat)
    - Tungsten (25um)
    - Rhenium Tungsten (25um)
    - Beryllium Copper (25um)
    - Palladium (25um)
- Cleaning products in wafer format
- Common probe card metrology analysis
- Z only cleaning motion with indexing & OD extremes

3µm-LF SEM Comparison

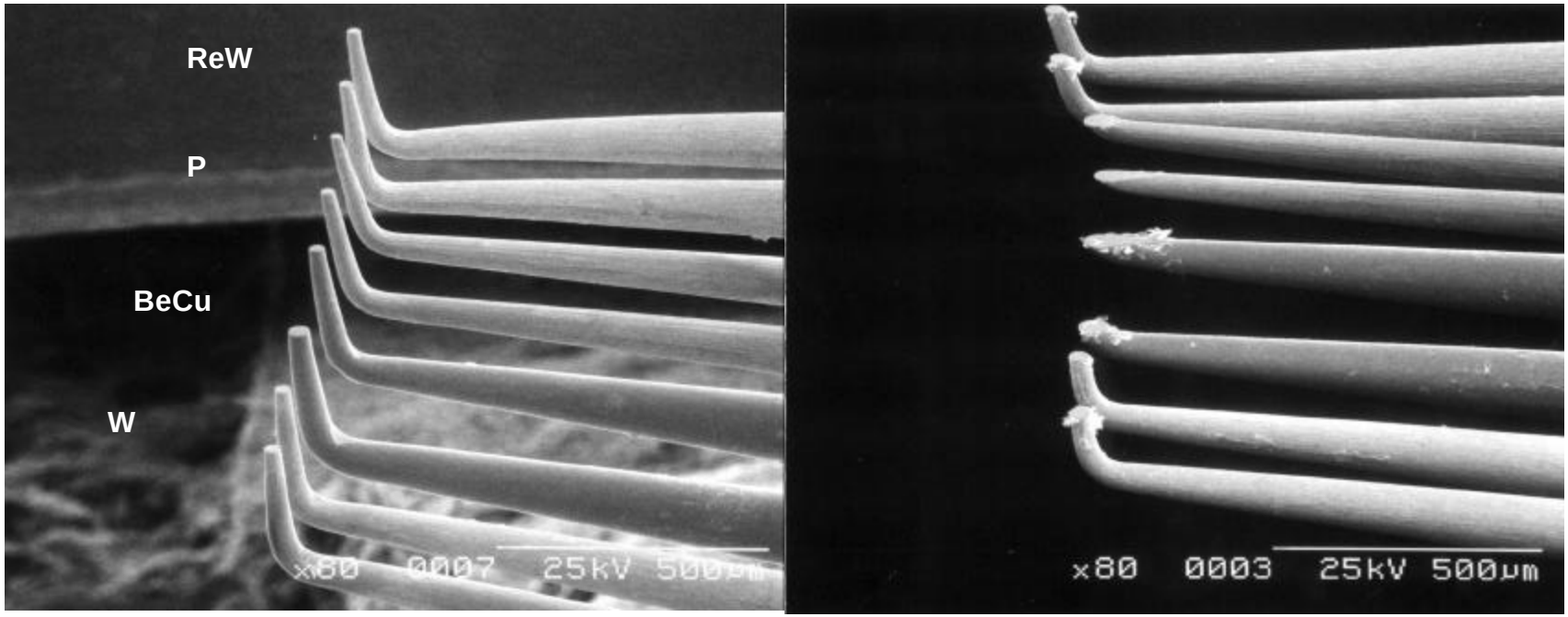


Baseline



100k Touchdowns

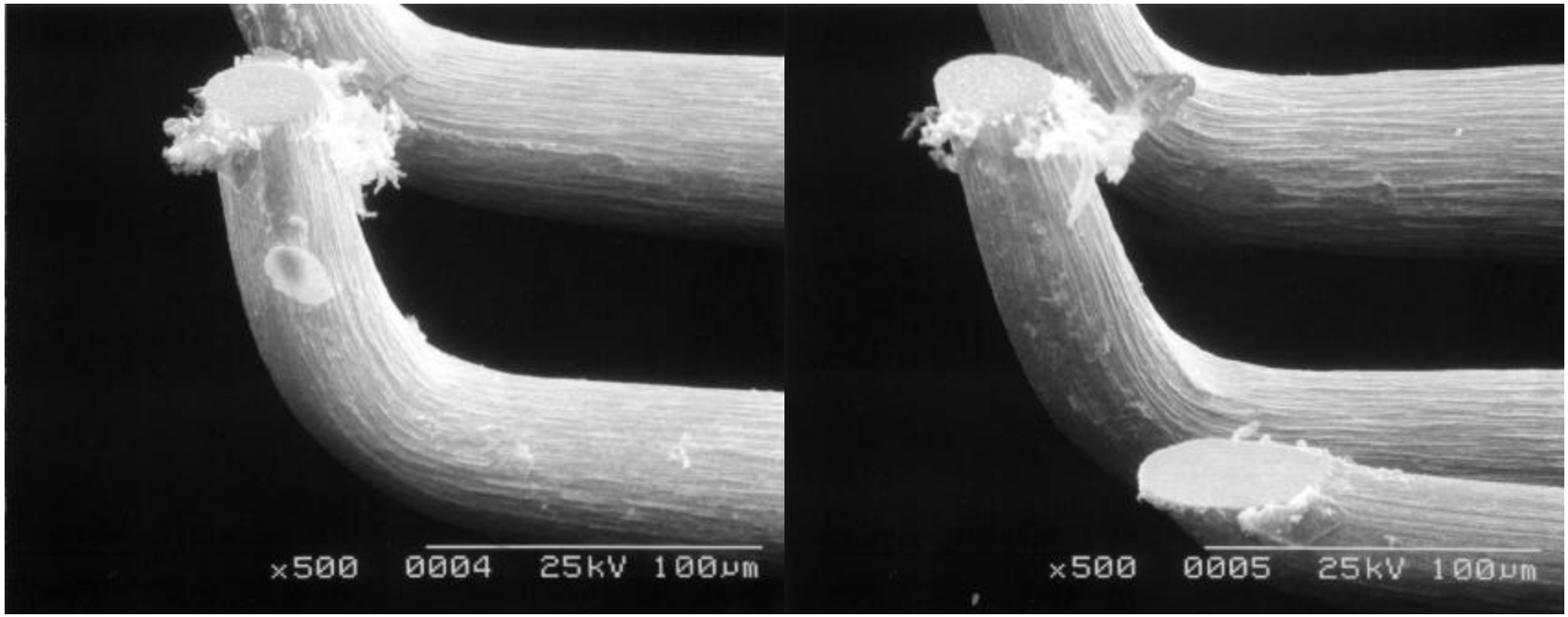
0.5µm Cushion Lapping Film



Baseline

100k Touchdowns

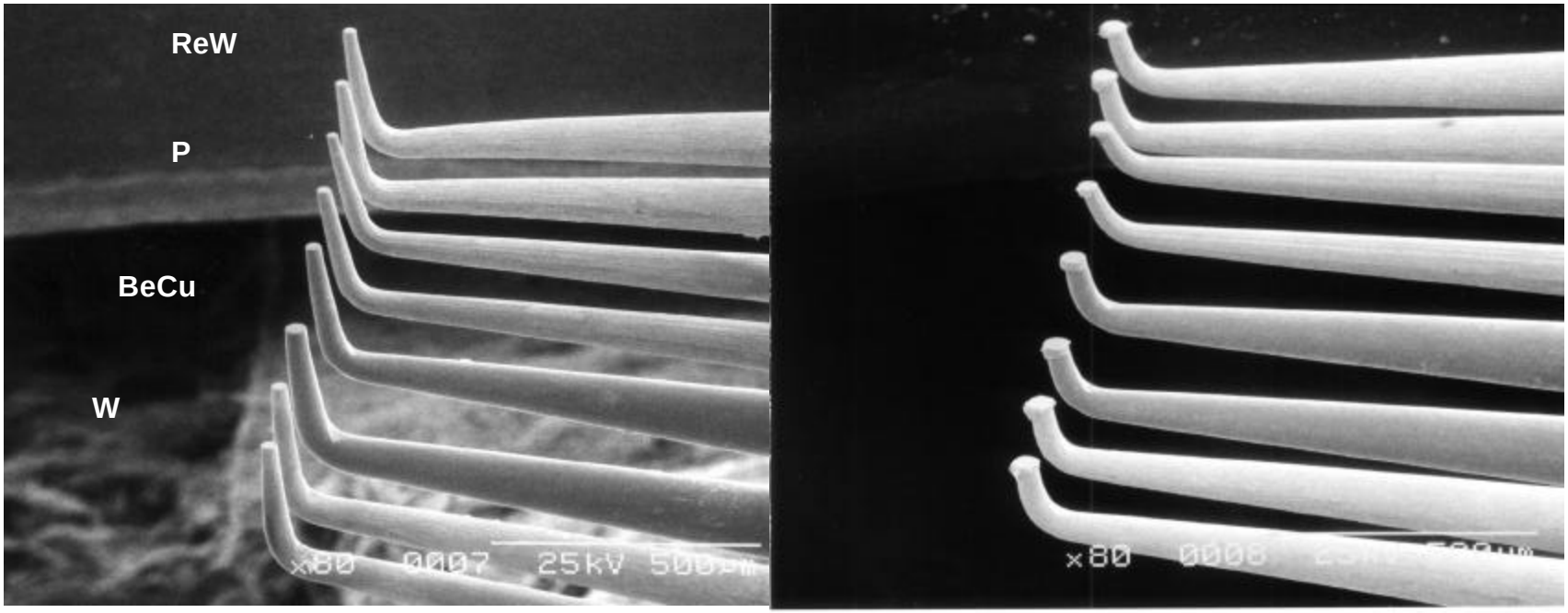
Sanding Debris



Tungsten - 75µ l

Rhenium Tungsten - 80µ l

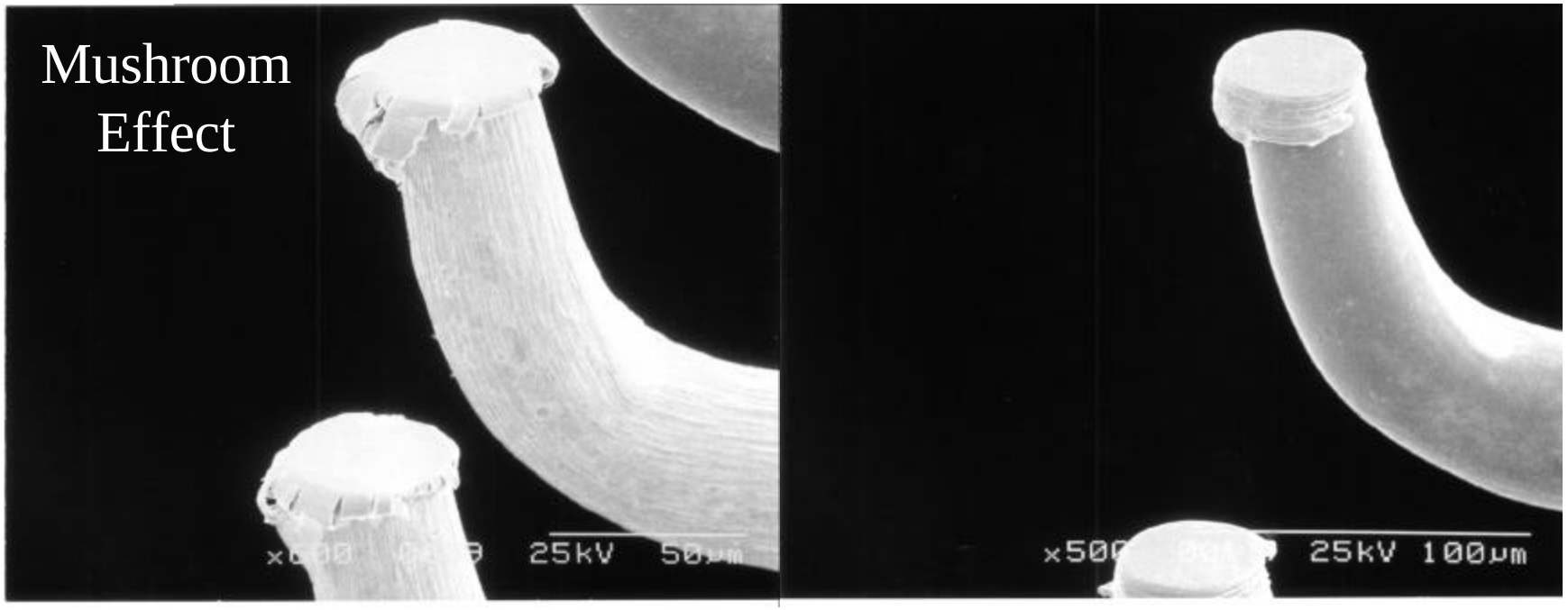
Tungsten Carbide SEM Comparison



Baseline

500k Touchdowns

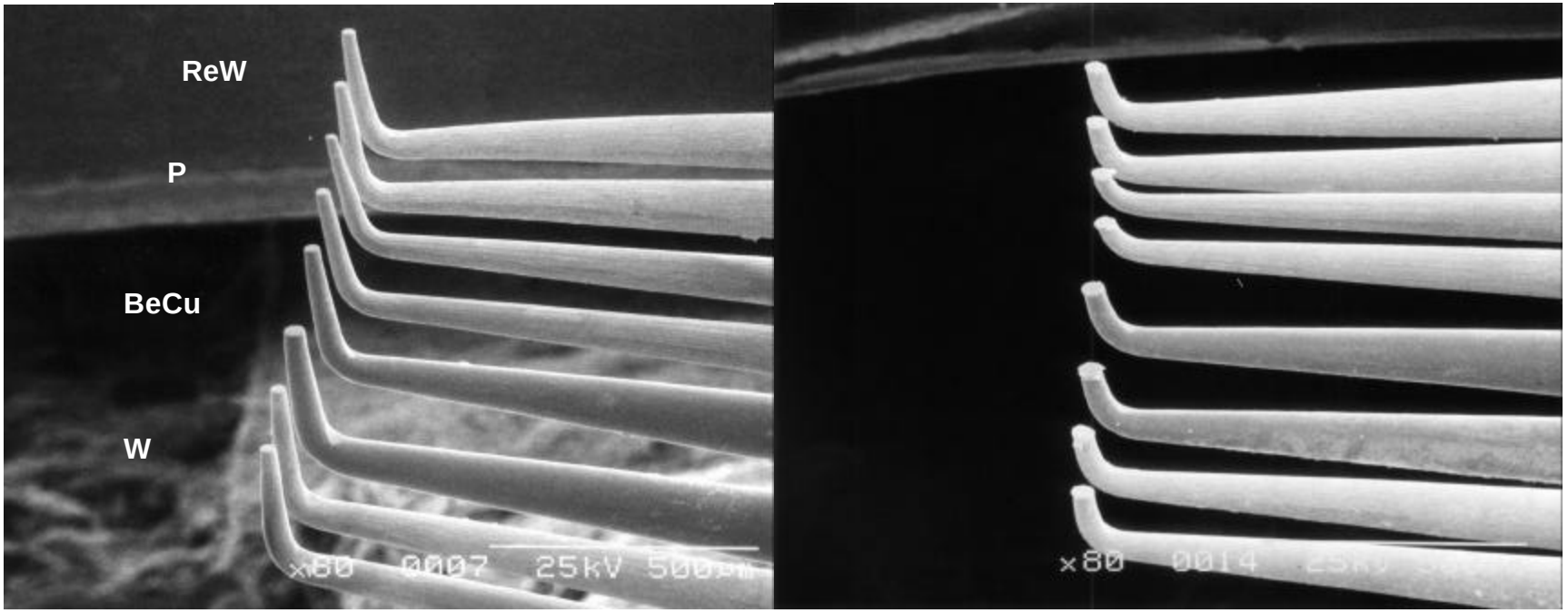
Tungsten Carbide Photos



Tungsten

Beryllium Copper

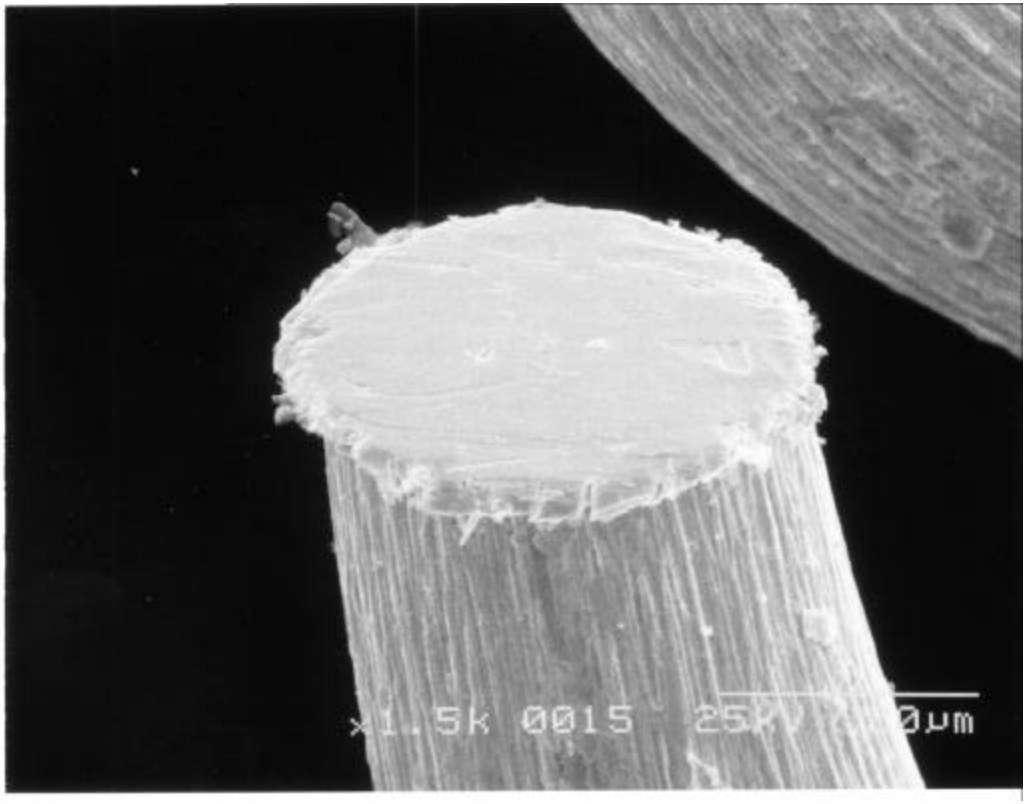
Custom Ceramic SEM Comparison



Baseline

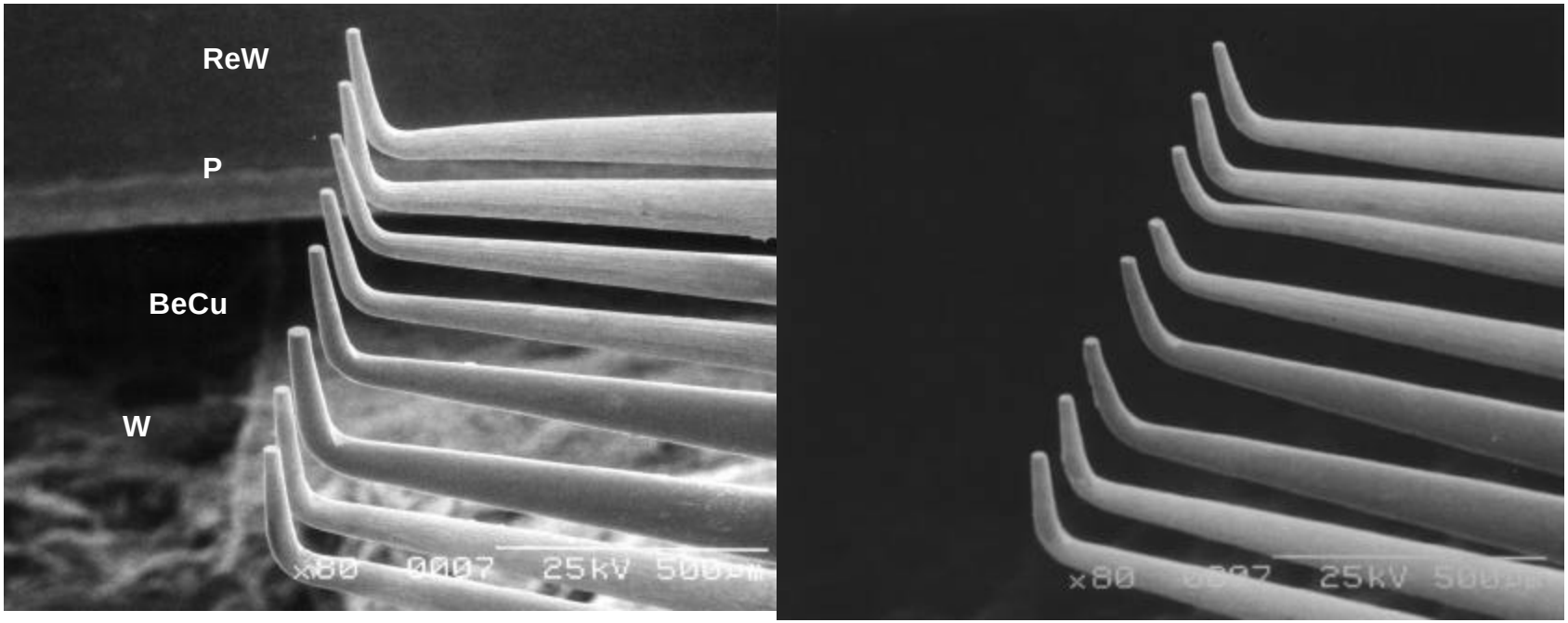
500k Touchdowns

Custom Ceramic Photos



Mushroom Effect

Probe Polish 99 SEM Comparison



Baseline

1 Million Touchdowns

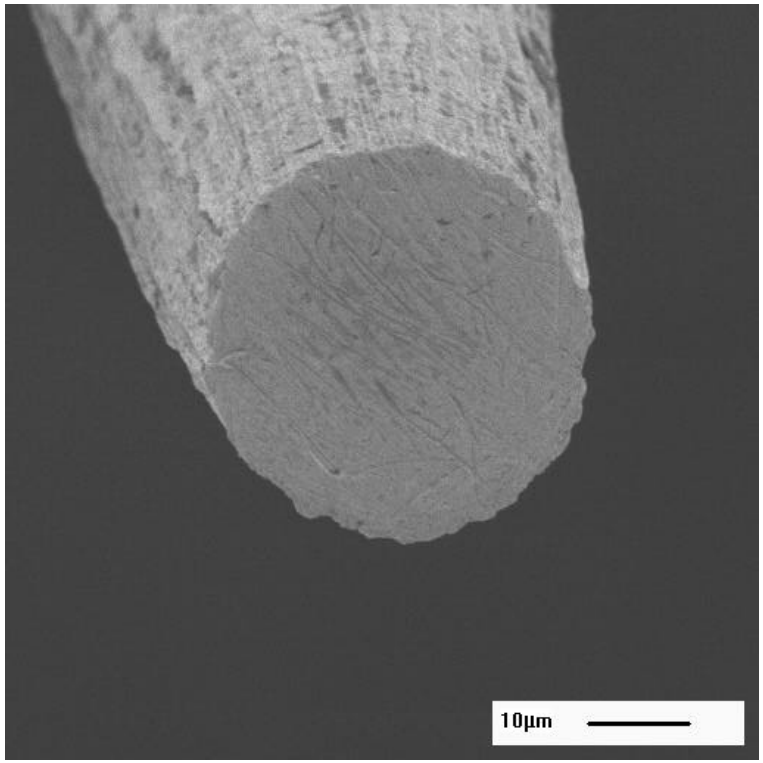
Durability Conclusions

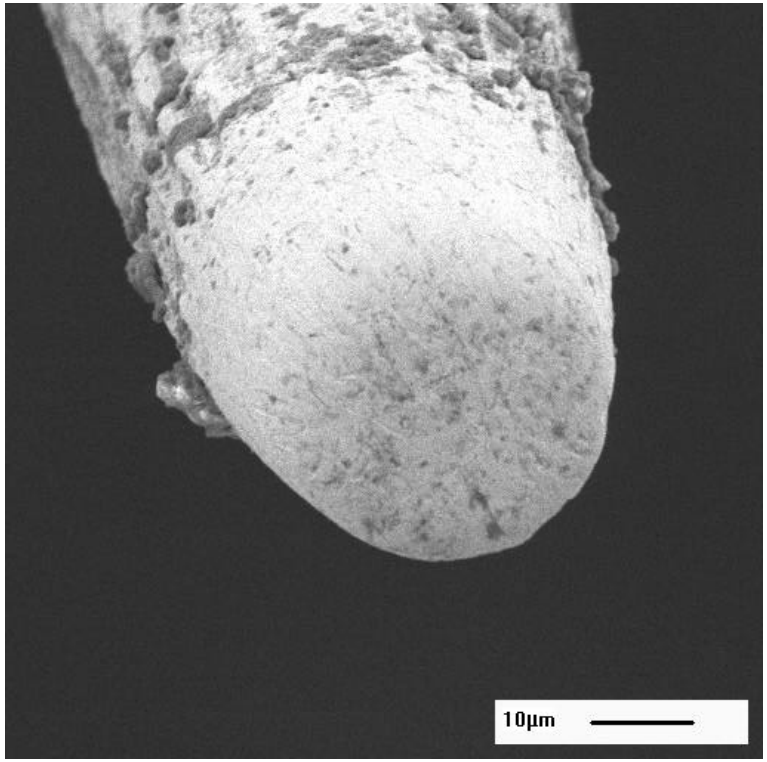
- ReW and W Most Durable
- P and BeCu Much Less Durable
- Tungsten Carbide and Ceramic Less Destructive Than Any Lapping Film
- Probe Polish Least Destructive

Reshaping Tests

- On Going Research
- Goals
  - Reshaping Materials for Each Common Probe Materials
  - Control the Shape
  - Cost Effective Option to Extend Probe Card Life

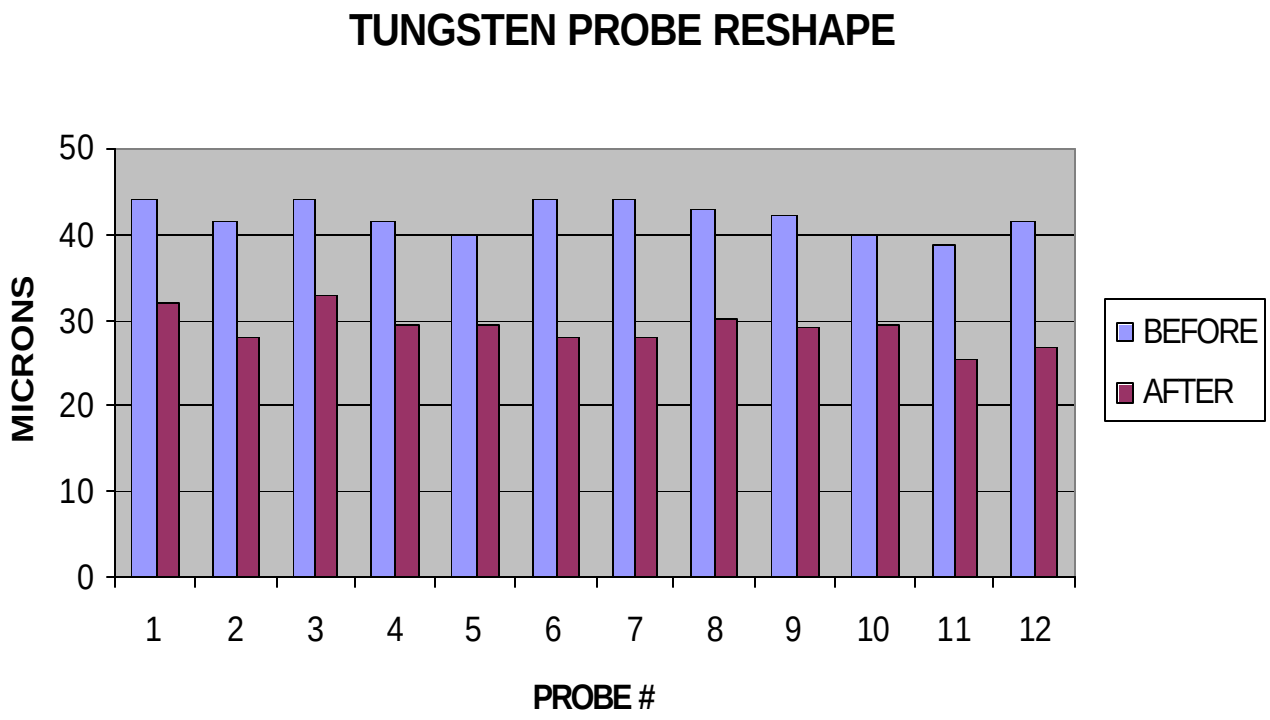
BEFORE/AFTER



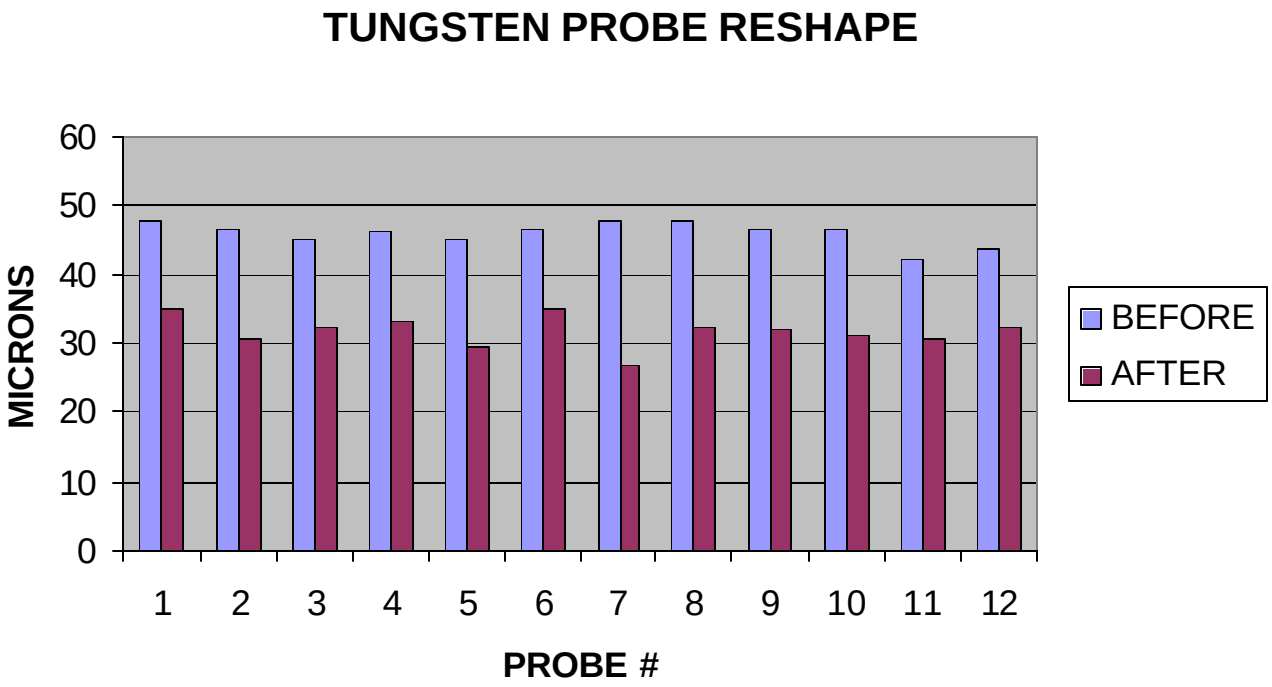


W Probe, 6000 Touchdowns

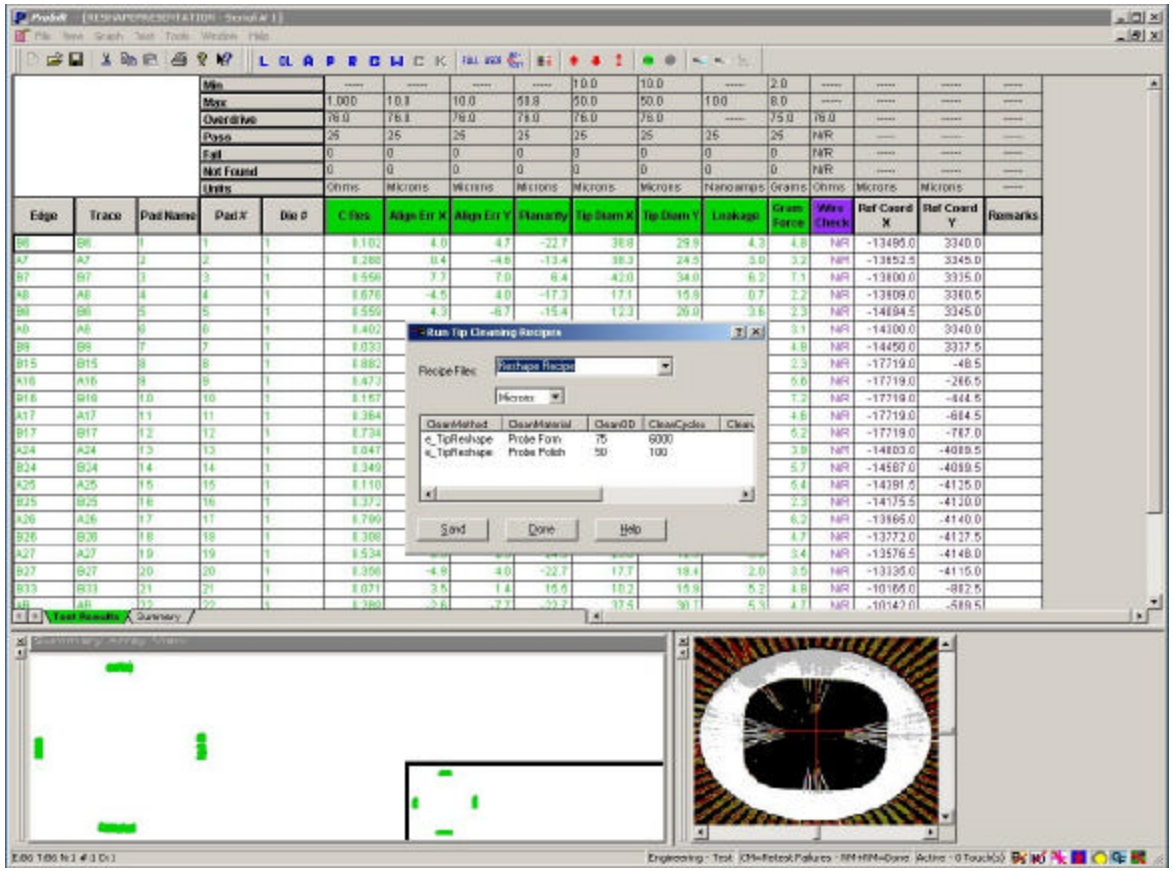
“X” DIAMETER CHANGE



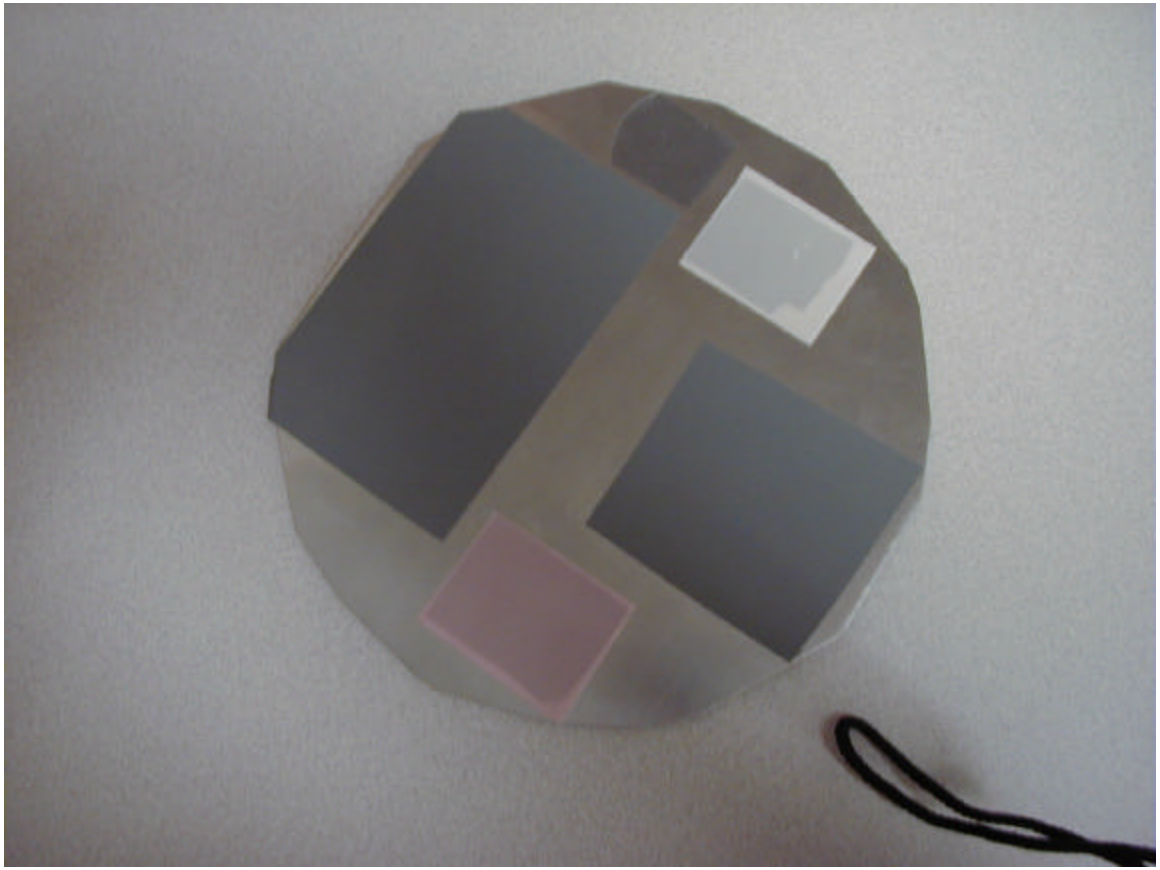
“Y” DIAMETER CHANGE



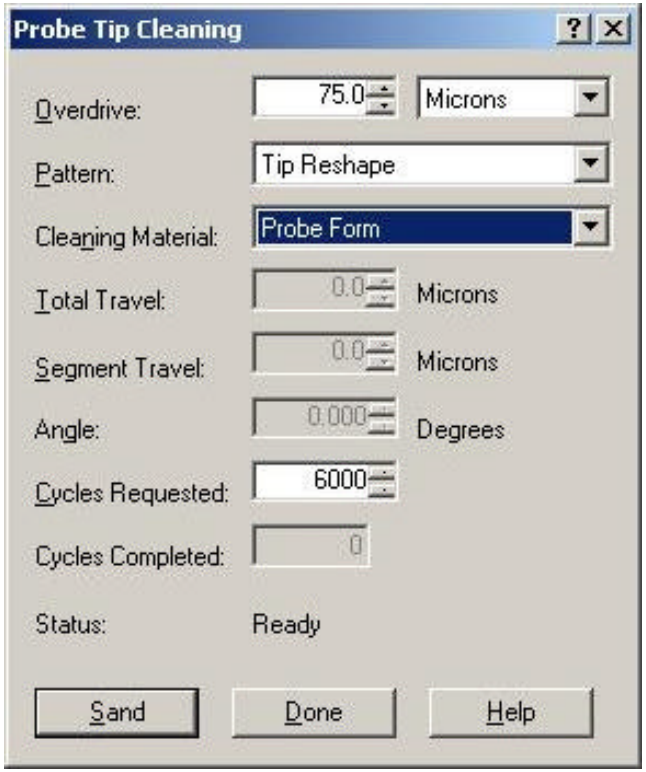
Reshaping Recipe



Reshaping Plate



Tip Cleaning Window



Conclusion

- The Cleaning Recipe Must be an Integral Part of the Overall Test Program
- Different Probe Materials Accumulate Debris at Different Rates
- Surface Roughness Effects Debris Accumulation

Conclusion

- Material Used in Cleaning Dramatically Effects Probe Card Life
- Reshaping Probes can Extend Probe Card Life