Polishing Pad Impact on the Yield on W CMP

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Acknowledge

- Work was done at ProMos Technologies, Inc.
  - Ron Lin, Joseph Tung, and Robert Chan

- Product
  - 300 mm memory devices
  - 0.14 um technology with local interconnect
- CMP consumables
  - Ferric nitrate slurry
  - TWI W711 pad and polyurethane pad

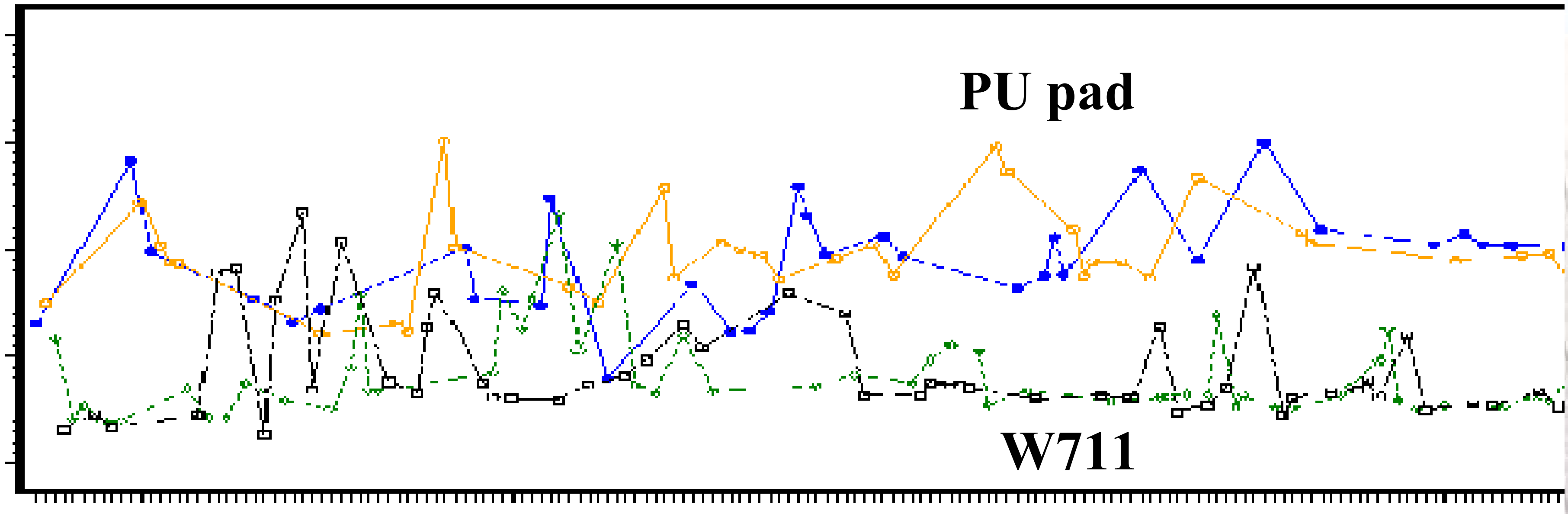
Avenues to Impact Yield in CMP

- WIWNU
  - Local over-polishing / under-polishing
- Defect
- Metal loss / oxide loss
  - Dishing / erosion -- resistance

Factors Affecting WIWNU

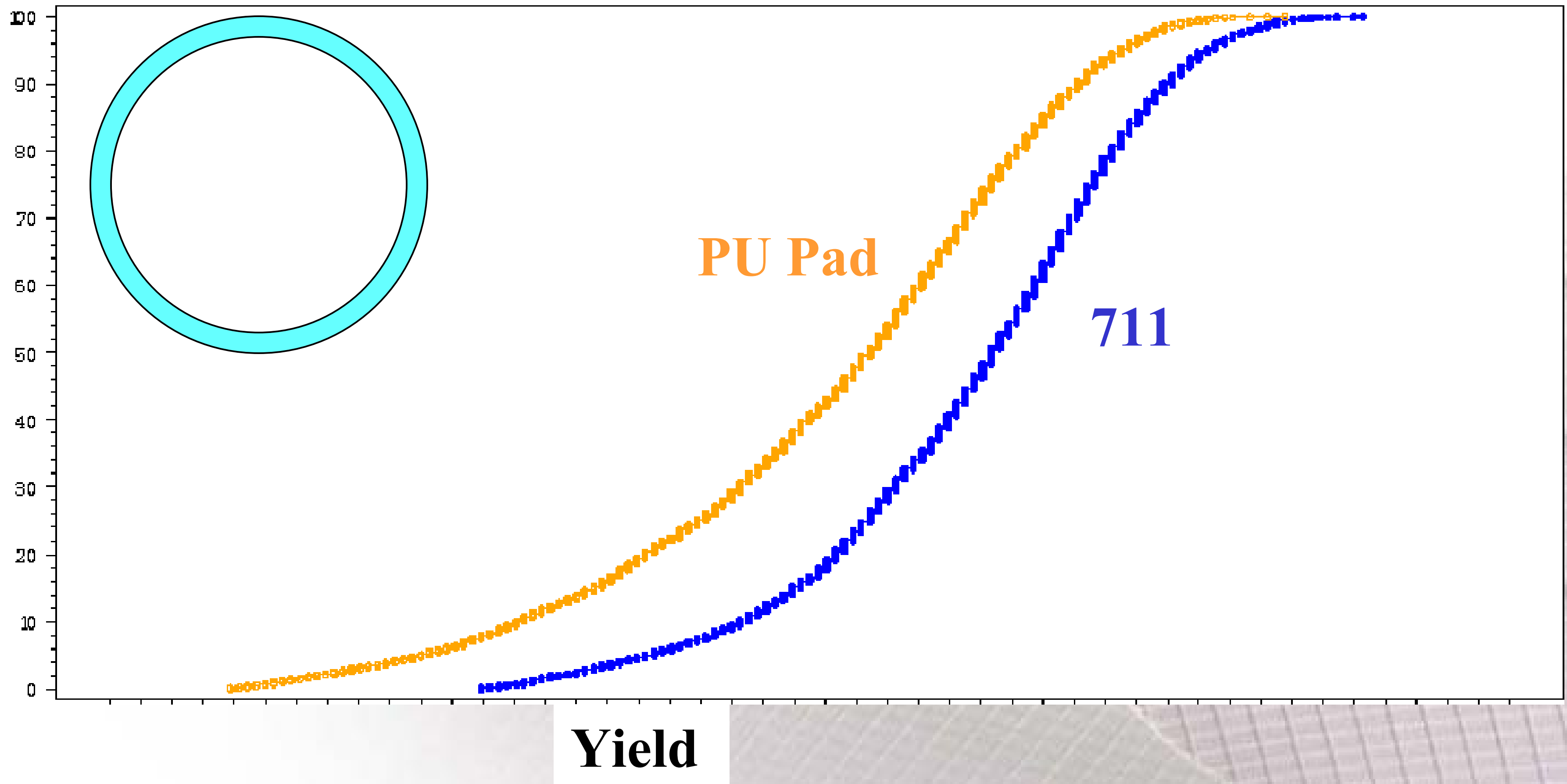
- Incoming wafer profile
- Polishing tool / wafer carrier
- Slurry
- Pad
  - Slurry transport mechanism
  - Slurry retention capability
  - Response to conditioning
  - Pad uniformity
    - Thickness, property

WIWNU of Blanket Wafer

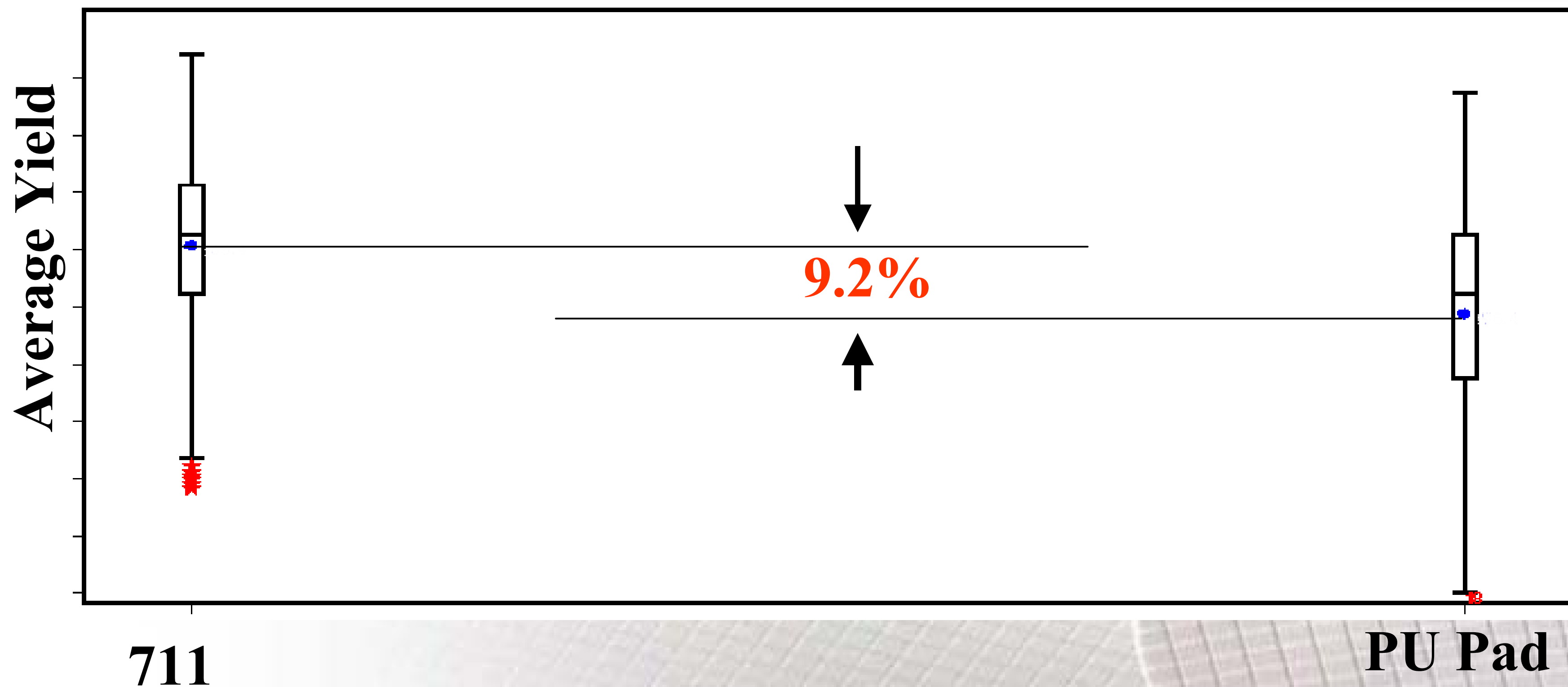


In-line monitor results
The WIWNU on W711 is about half of NU on polyurethane pad.

Yield of the Edge Region



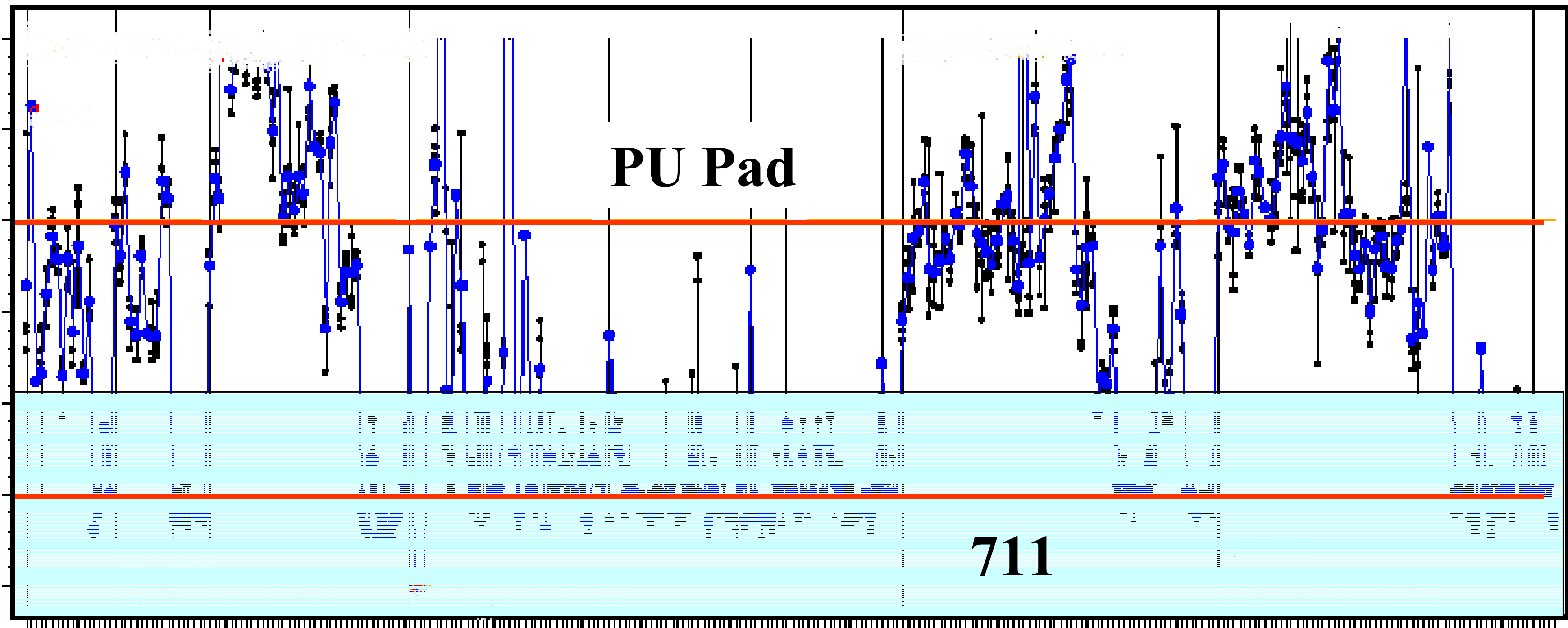
Yield of the Edge Region



Factors Affecting Defect

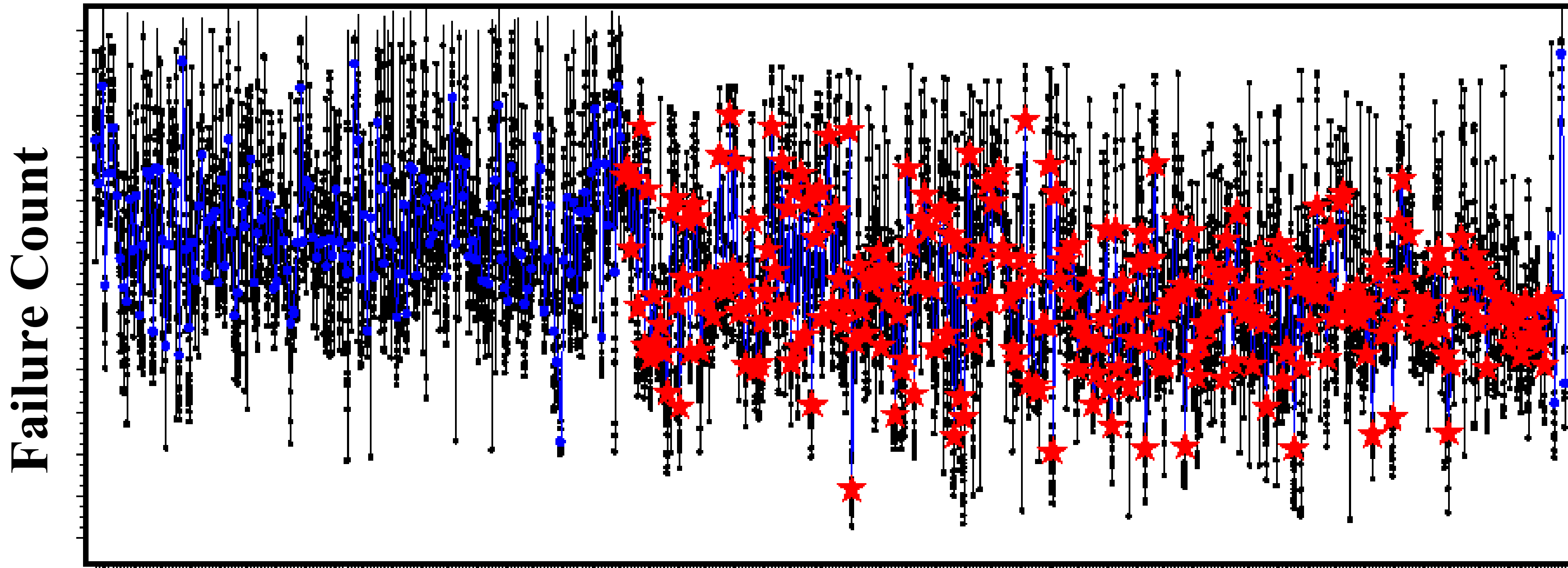
- Hardware system
  - Slurry delivery system / filtering system
  - Polishing tool / wafer handling
  - cleaner
- Slurry
  - Abrasive type
  - Abrasive size and distribution
  - Chemicals / agglomeration
- Conditioner
- Pad properties
  - Hardness
  - Mechanism to remove polishing debris

Defect Count in M0 Device
(local interconnect)



The defect count on 711 is only about one quarter of defect count on PU pad

Bit-line Failure Count



Red symbol: 711
Blue symbol: PU pad

Bit-line Failure Count

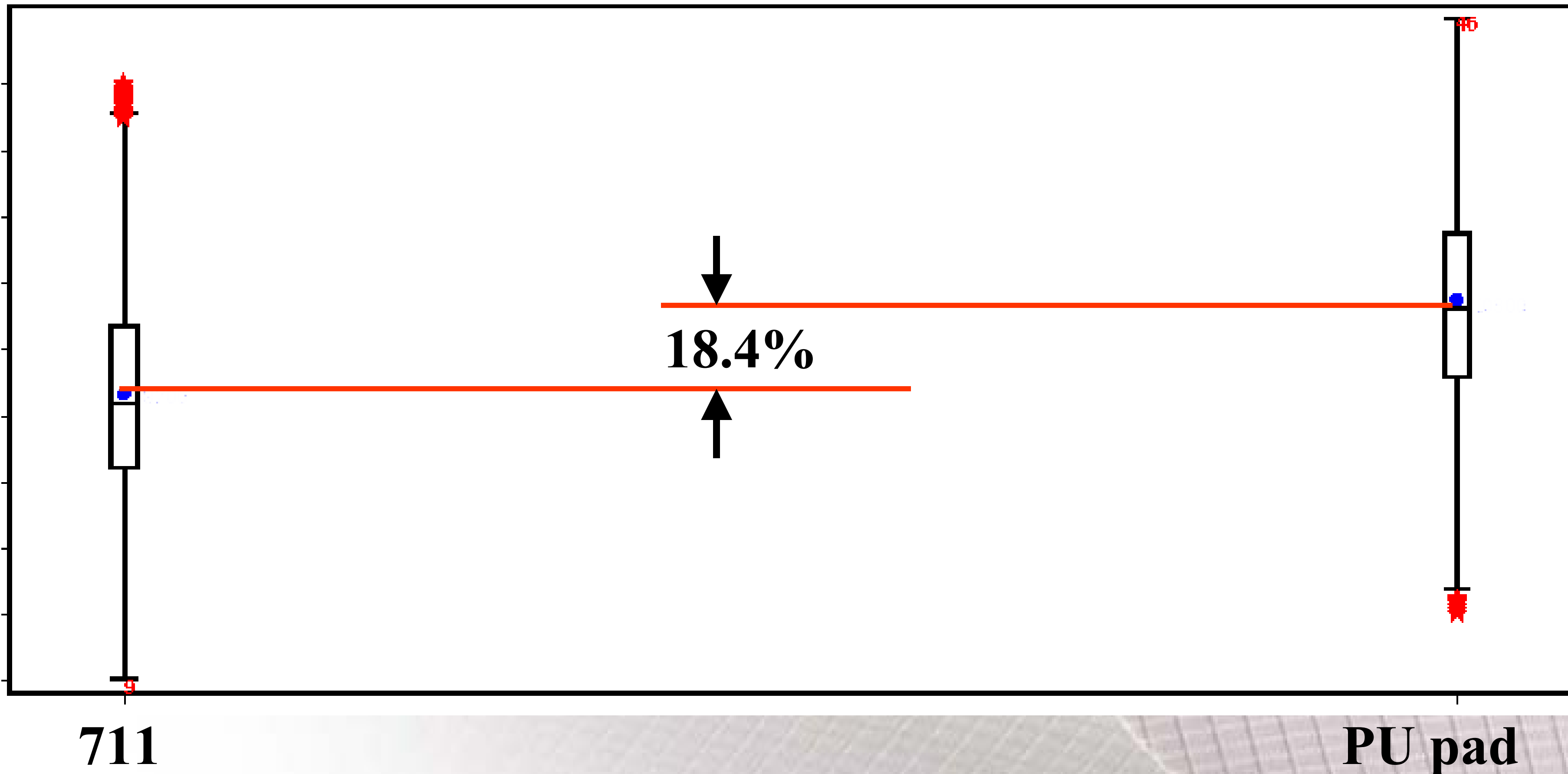
100
90
80
70
60
50
40
30
20
10
0

711

PU Pad

Bit line failure count

Bit-line Failure Count

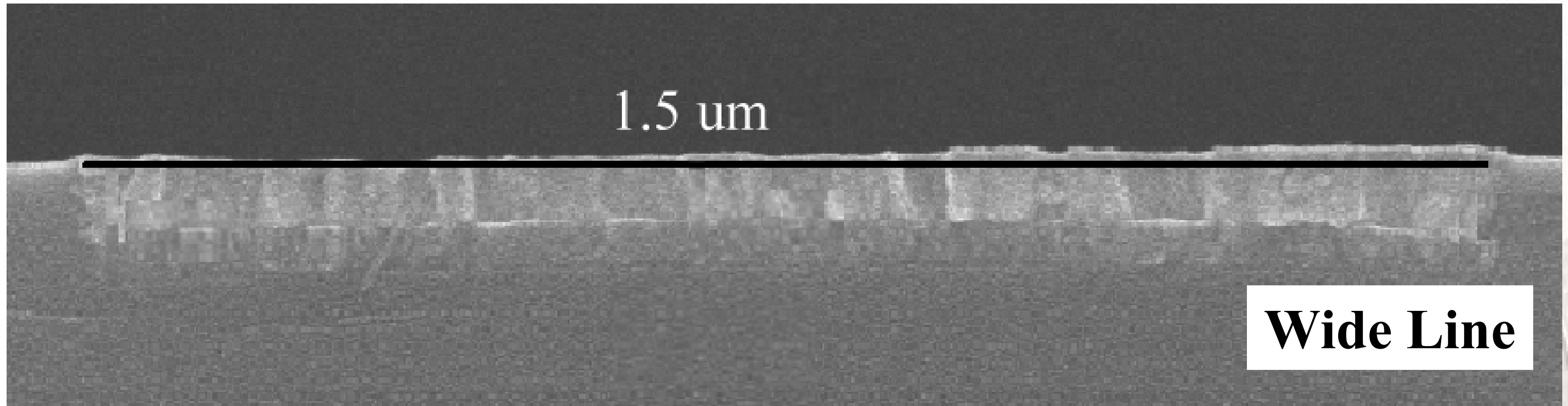


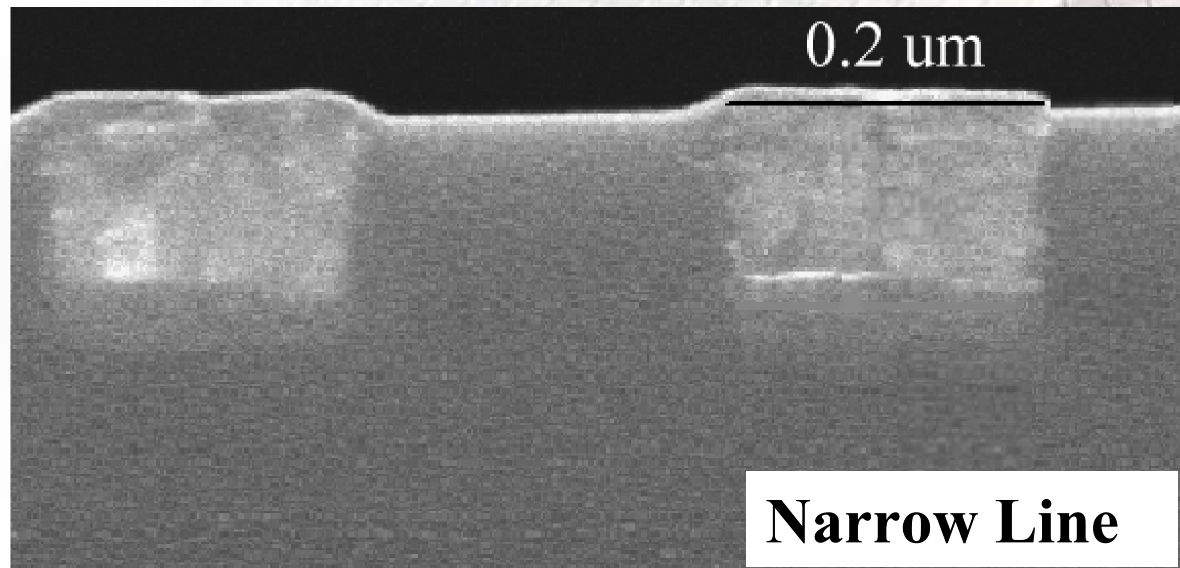
Failure rate on 711 is ~18.4% lower than that on PU pad

Factors Affecting Metal Loss

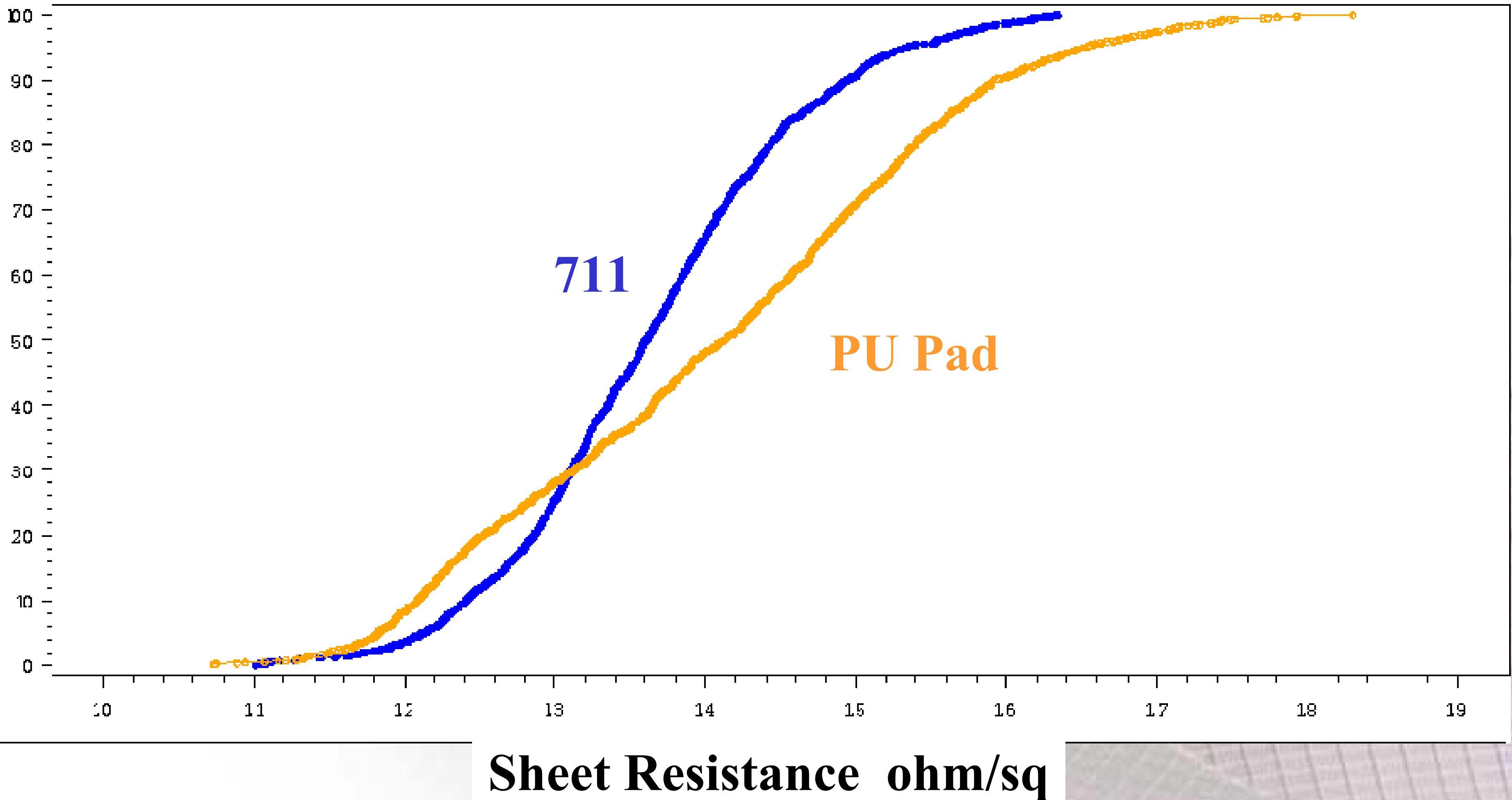
- Slurry properties
  - Selectivity on various films
  - Chemical etching rate
- Pad properties
  - Selectivity on various films
  - Pad stiffness / planarization
  - Surface finishing

Resistance Measurement Structure

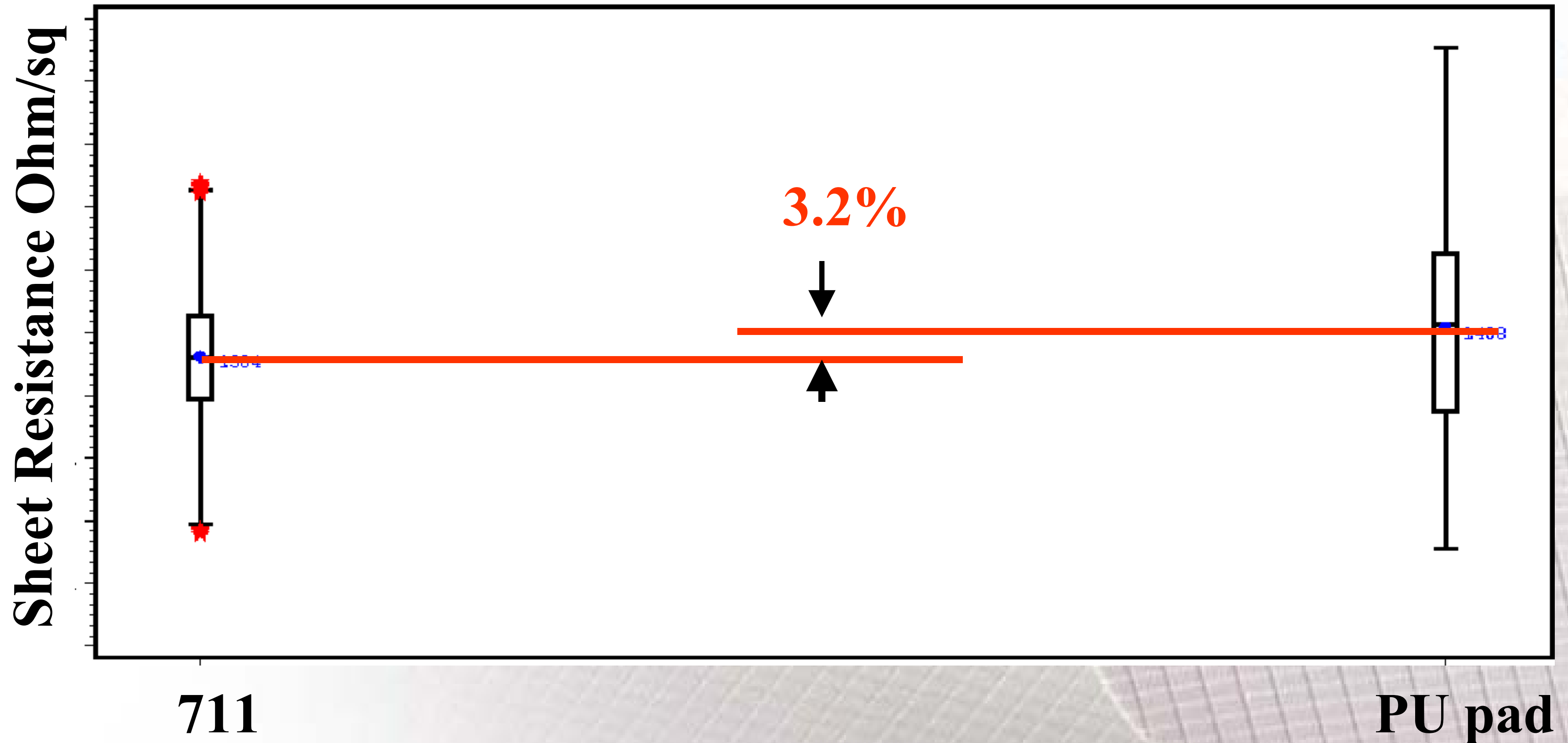




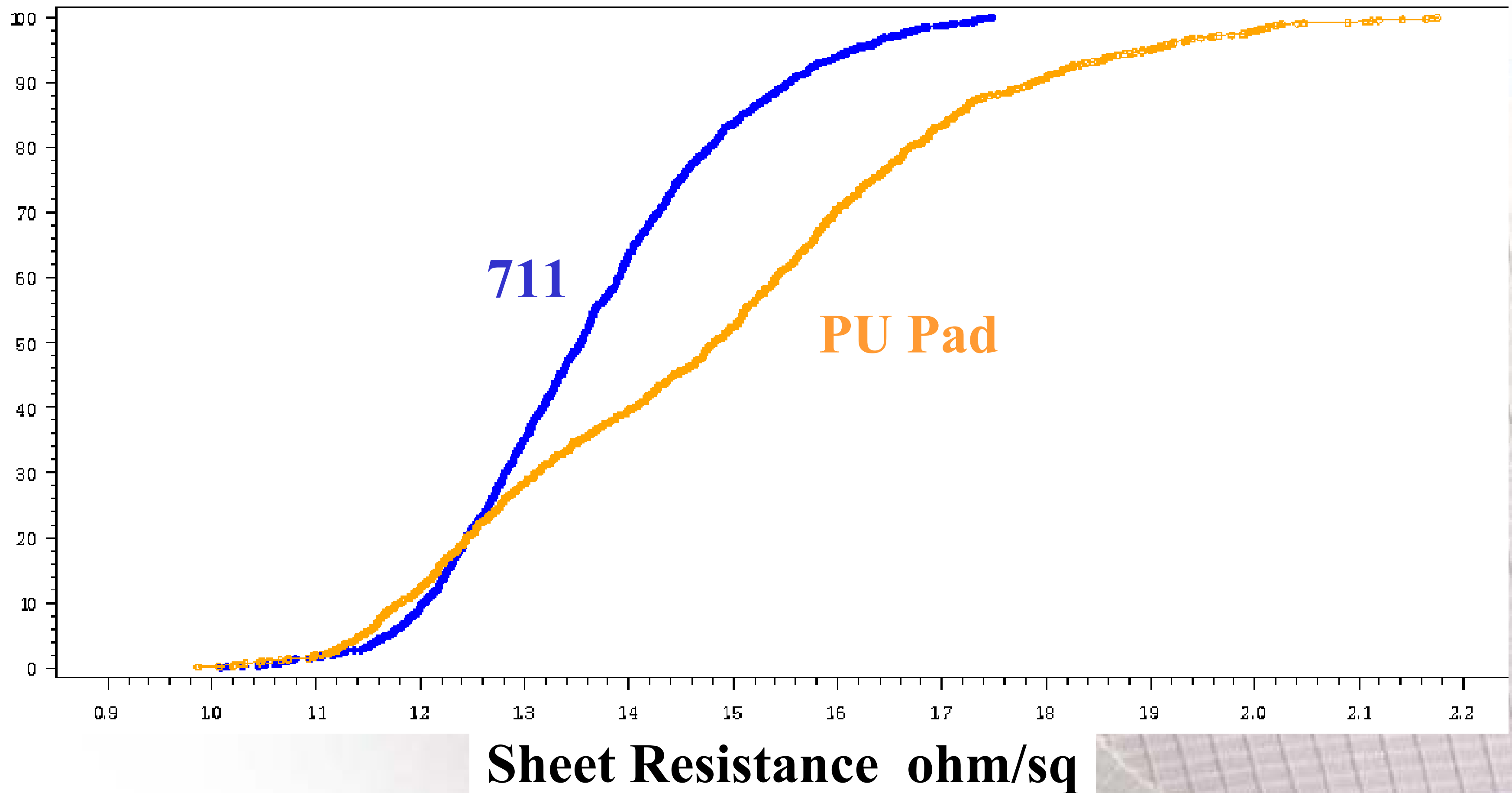
Sheet Resistance of Narrow Line



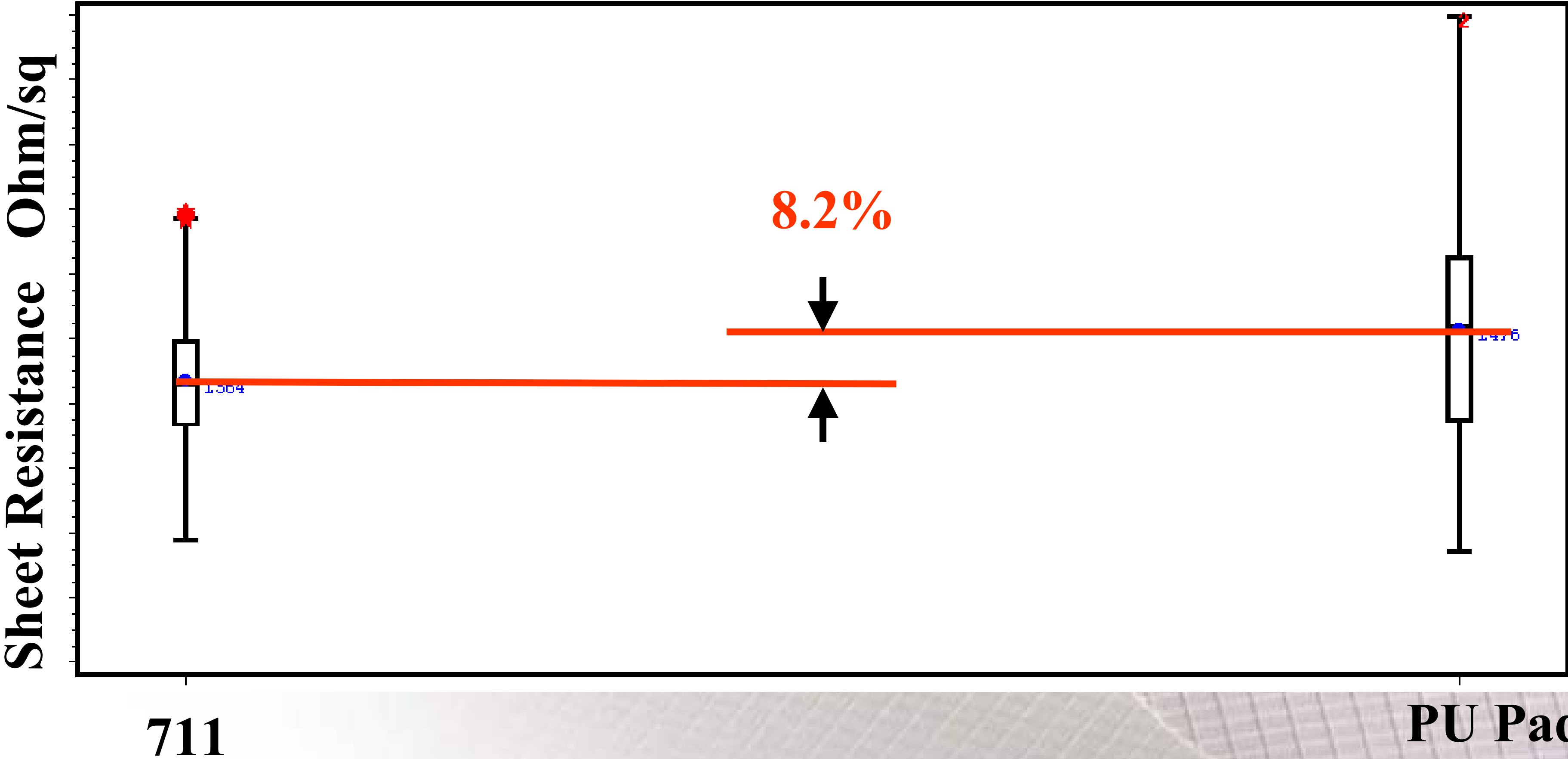
Sheet Resistance of Narrow Line



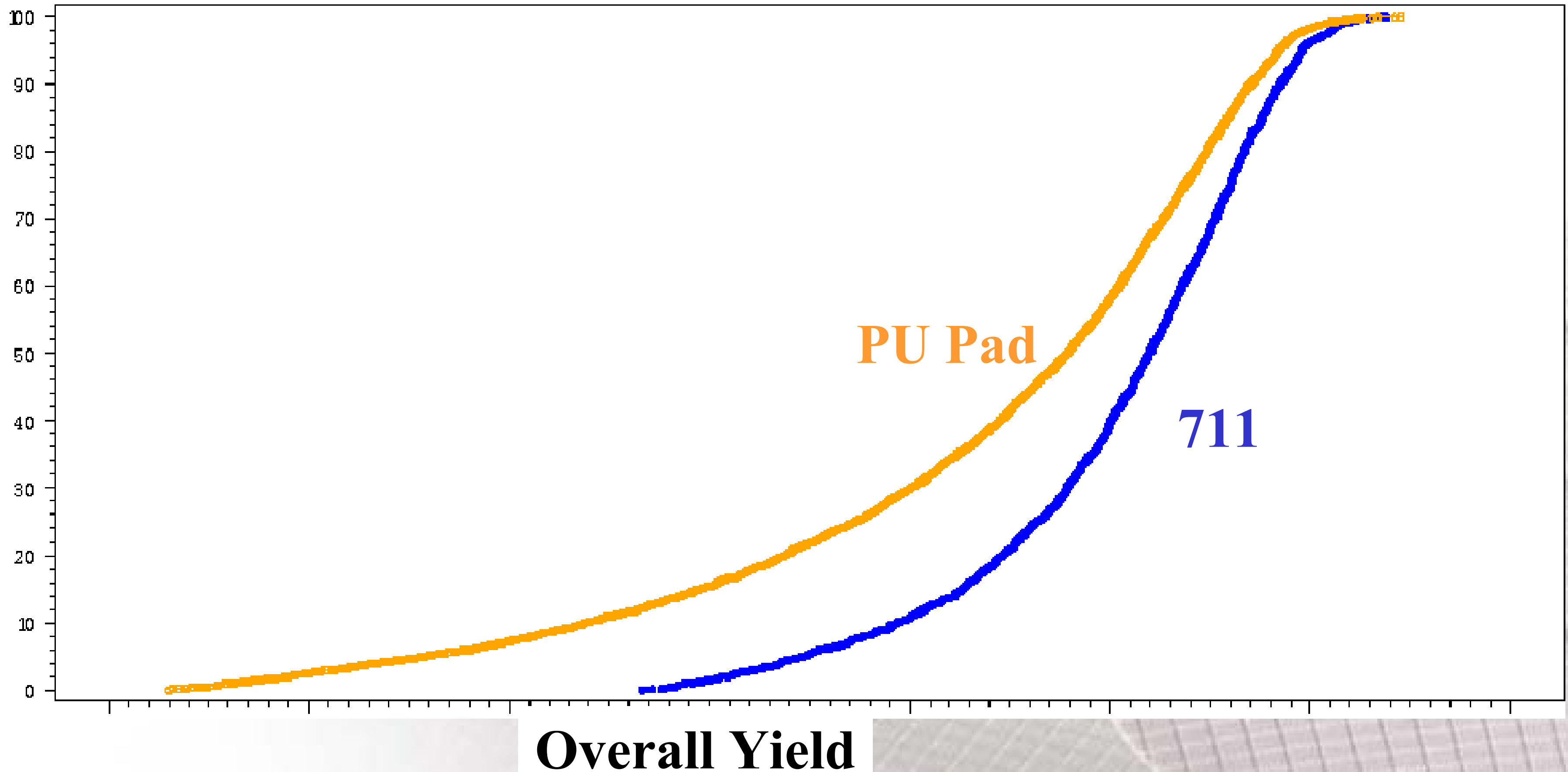
Sheet Resistance of Wide Line



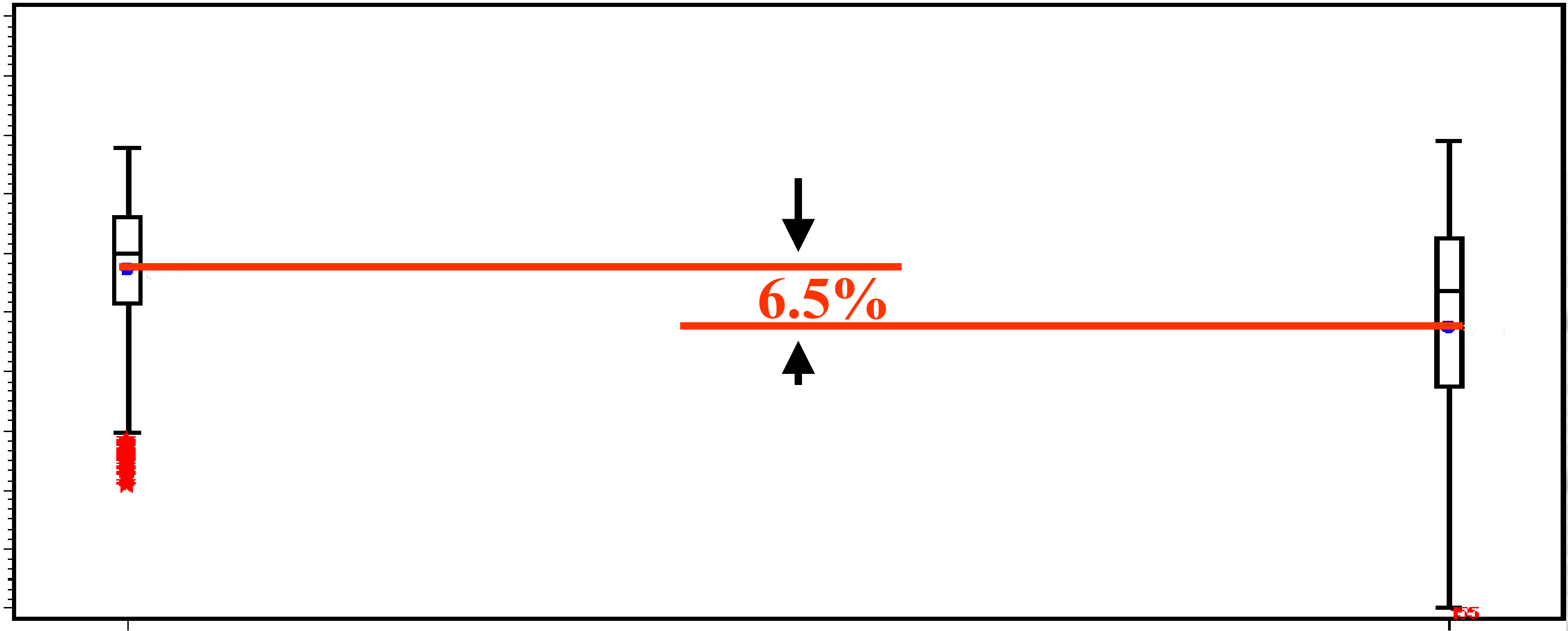
Sheet Resistance of Wide Line



Summary –Overall Yield



Summary –Overall Yield



Summary

- Polishing pad can have significant impact on yield. The influence can be attributed to
  - WIWNU
  - Defect
  - Metal loss