Polishing Pad Impact on the Yield on W CMP

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Acknowledgement

• 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
  - 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

PU Pad

711
Yield of the Edge Region

Average Yield

9.2%

711

PU Pad
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

Bit line failure count

711

PU Pad
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

1.5 um

Wide Line

0.2 um

Narrow Line
Sheet Resistance of Narrow Line

Sheet Resistance ohm/sq
Sheet Resistance of Narrow Line

Sheet Resistance Ohm/sq

3.2%

711

PU pad

CMPUG May, 2004
Sheet Resistance of Wide Line

Sheet Resistance ohm/sq

PU Pad

711

CMPUG May, 2004
Sheet Resistance of Wide Line

Sheet Resistance (Ohm/sq)

- 711
- PU Pad

8.2%
Summary – Overall Yield

Overall Yield

PU Pad
711
Summary – Overall Yield

6.5%
Summary

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