Au-Au DIRECT BONDING

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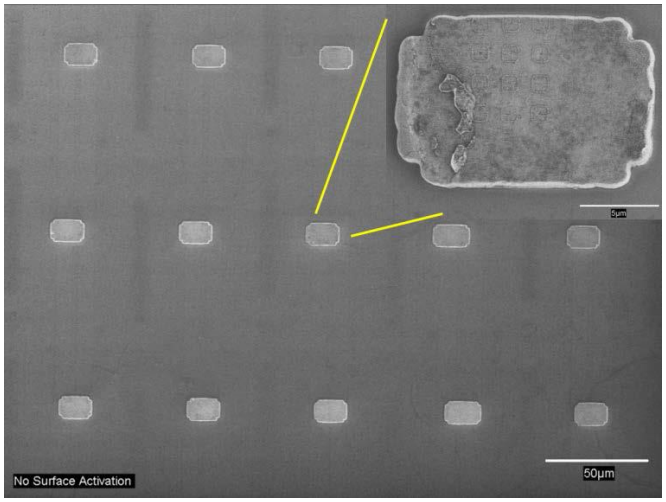
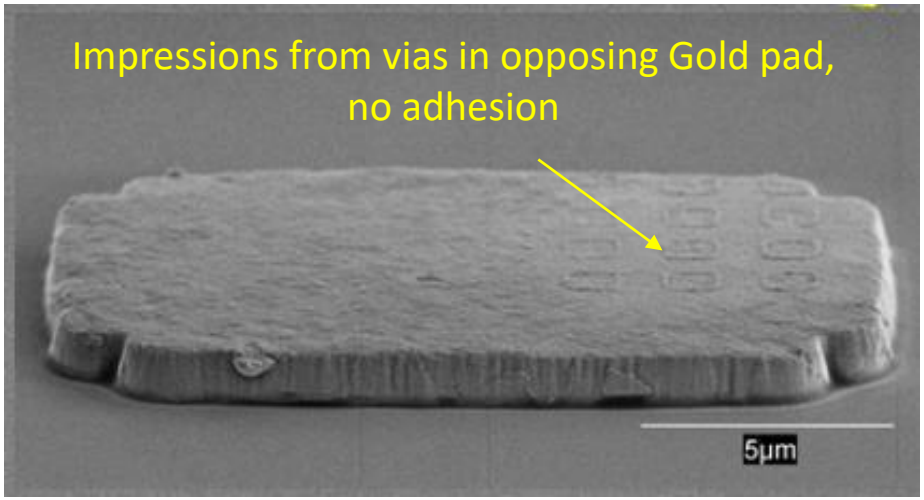
Gold-to-Gold Direct Bonding

- An unexpected bonding benefit was discovered while bonding Gold pads to Gold pads for a flip-chip configuration. Low-temperature compression bonding (necessitated by chip temperature restrictions to 200°C) had yielded very poor adhesion between Gold pads, even though there was significant visual pad-to-pad compression (Figure 1).

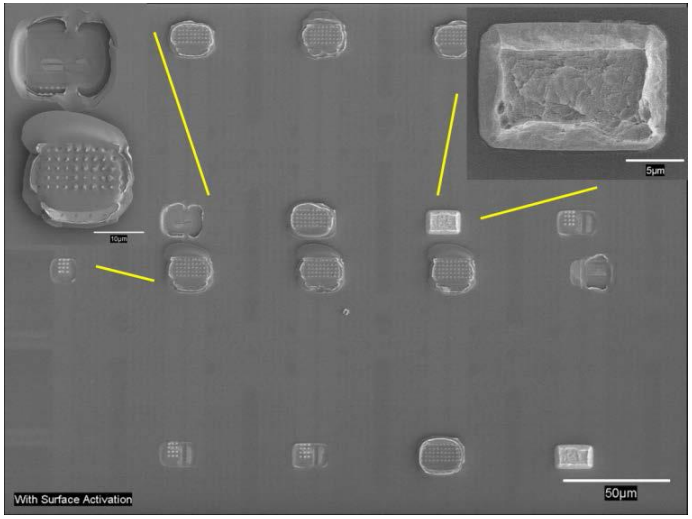


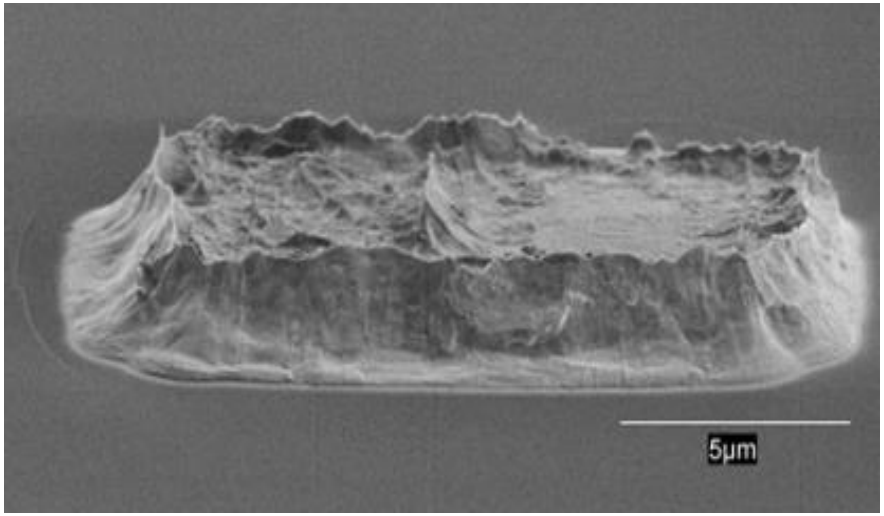


- Figure 1 – Untreated Gold pads show adequate compression, but nearly zero adhesion following 200°C thermo-compression bonding and pull test.

Gold-to-Gold Adhesion with Ontos7

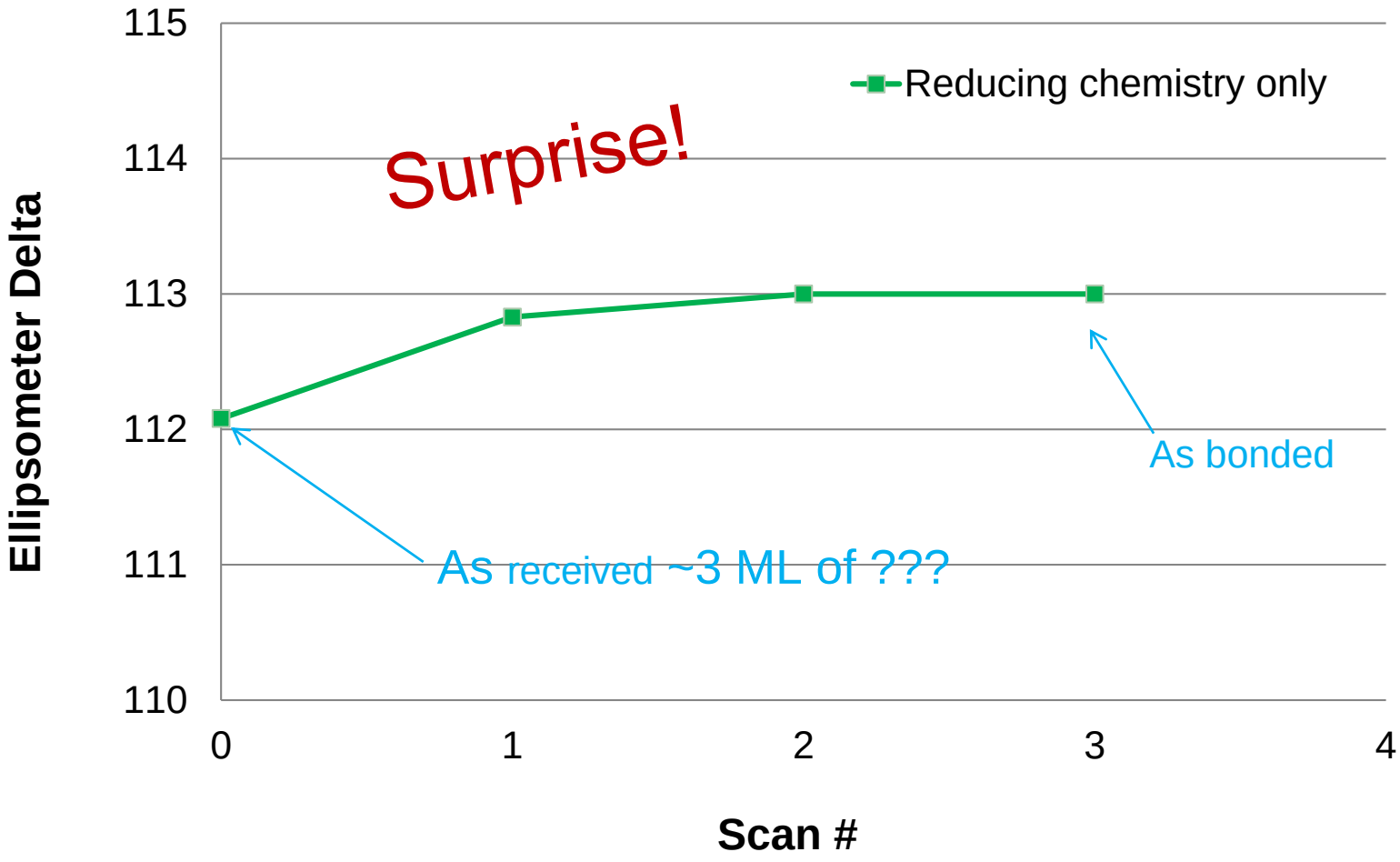
- Sister die were treated with SETNA's atmospheric plasma surface preparation process and then bonded under identical conditions, yielding remarkable Gold-to-Gold adhesion. Pull-apart tests showed metallurgical tensile rupture within the Gold bulk, and adhesion was so good that many Gold bond pads were ripped away from the substrate, taking chunks of underlying Silicon with them (Figure 2).





- *Figure 2 – 200°C Gold-to-Gold bonding after Ontos7 atmospheric surface treatment showed exceptional adhesion.*

Gold Response to Atmospheric Plasma Treatment



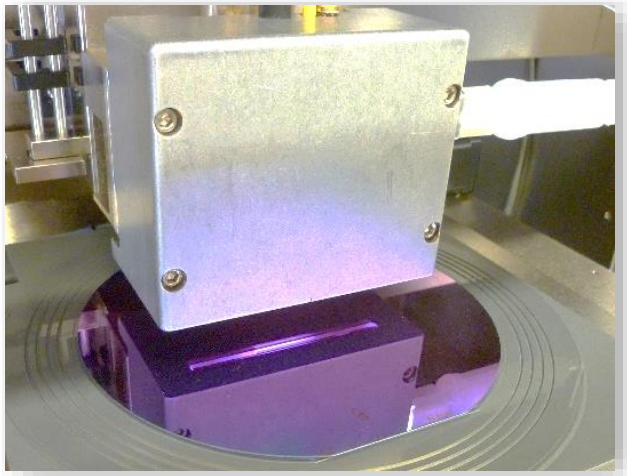
Discussion

- A small one degree change in Delta corresponds to approximately 2.5 - 3 monolayers of….?
  - Au_2O_3?
  - Organic residue from previous photoresist liftoff?, dicing protect?
  - Perhaps a monolayer or two of adsorbed H_2O, OH, or general atmosphere organics?
  - Need before/after XPS data.

Whatever the mechanism, Ontos7 Atmospheric Plasma surface treatment does an excellent job of cleaning and activating the Gold surface for metal-metal Thermo-Compression bonding.

Surface Activation with Ontos7

- **Simple** apparatus - no vacuum chamber.
- Plasma is **contained** entirely within the process head, never contacting the chip/wafer.
  - **Downstream** radical chemistry only.
  - **No** exposure to: arc discharges, charged particles, bombardment, re-deposition, or spalling particulates.
  - **CMOS safe, Detector safe**.



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Demo Lab in USA (Ventura-CA)

Demo Lab in Europe (Fraunhofer-IZM, Berlin)
(by special arrangement)

Our Demo Labs are ready to
demonstrate our capabilities on your parts. Call us:

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