Behaviors of thinned $2.5 \times 2.5 mm^2$ sensors

26 Dec. 2006
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Page 7: Revised: 27 Dec.
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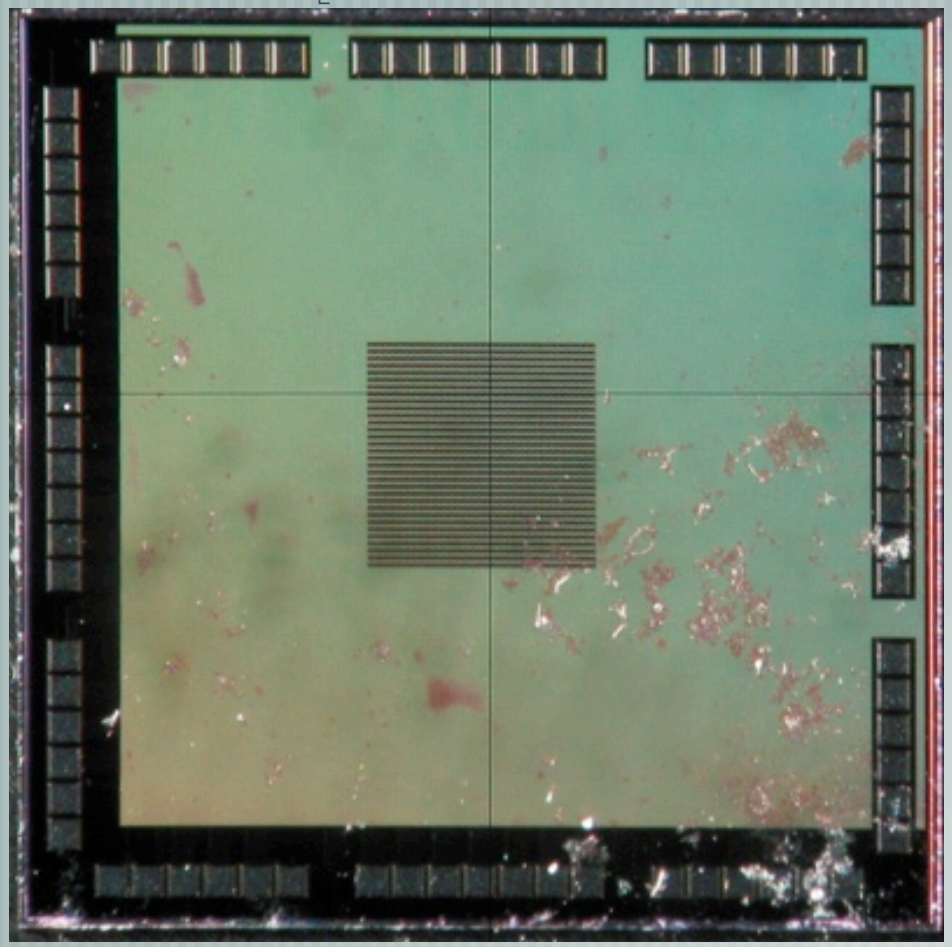
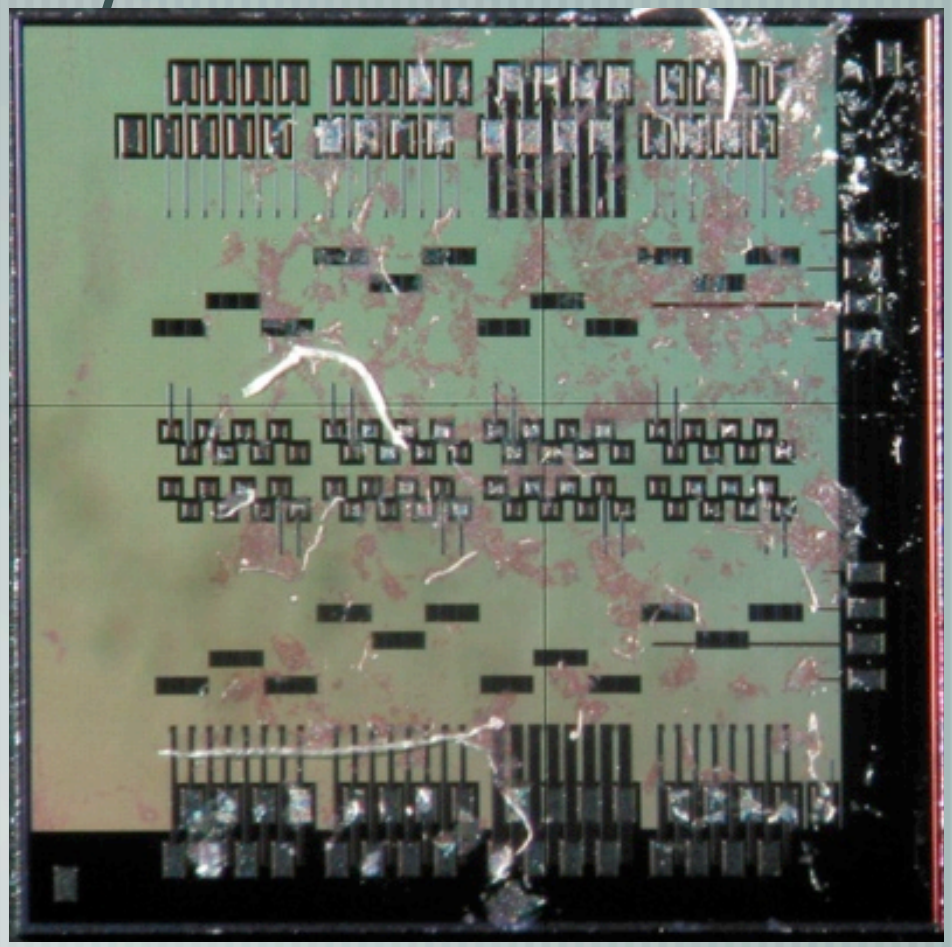
Thinned PIXEL and STRIP

- Done in
- On 21 Dec. 2006, I received the package.
- Package is OK.

The surface is dirty

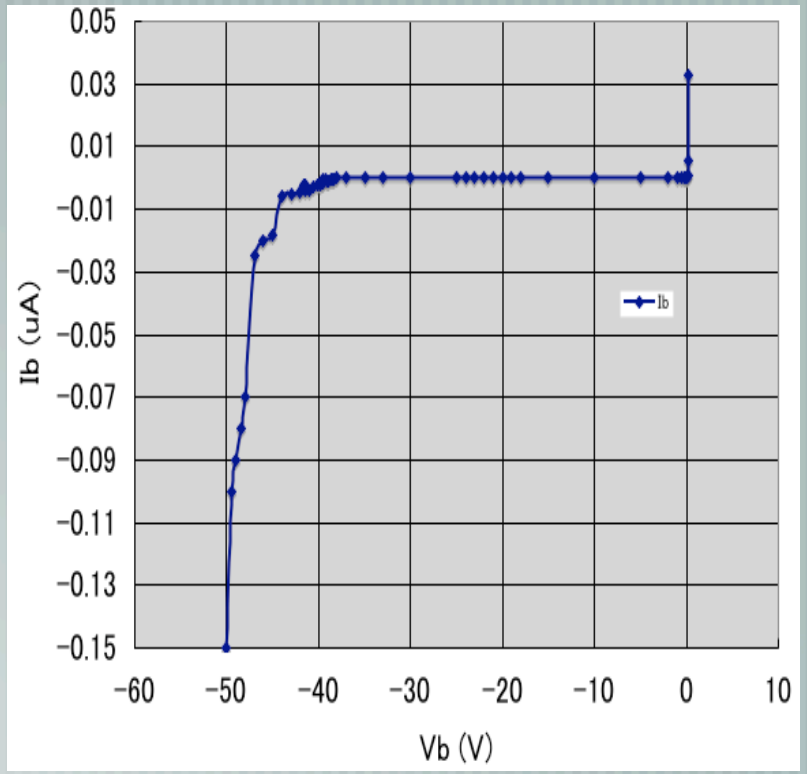
- The package is opened on 25 Dec. 2006.
- Evaluation is done as they are.





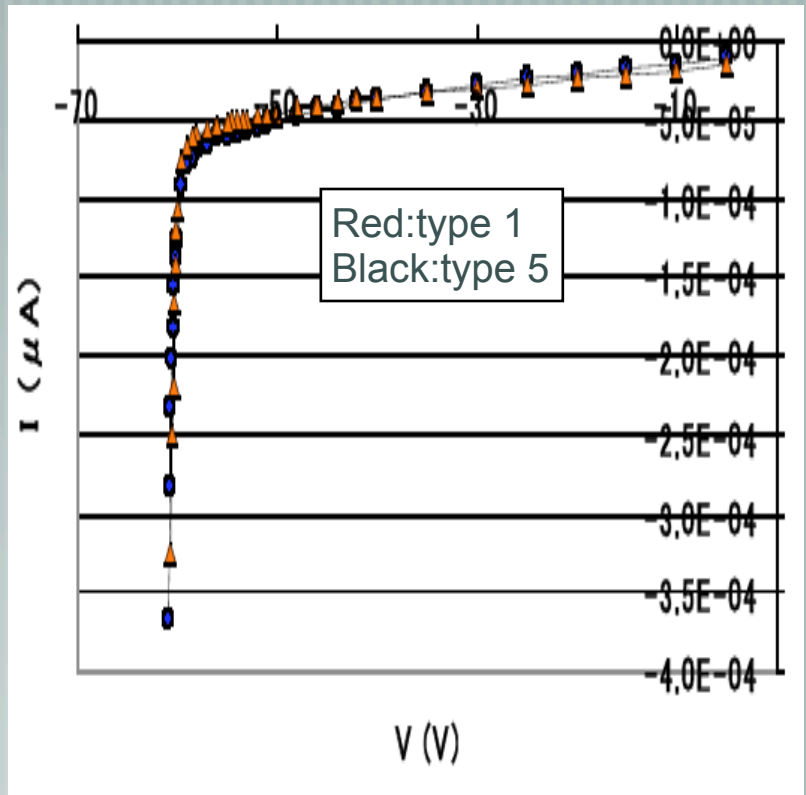
Quick result: I-V of strip

- K2400 source meter is connected to the sensor directly.
- The PN junction seems to be OK.
- Leak current is constant:
  - 0.06 nA/strip at Vb>-35 V.
- At Vb < -35 V, it takes 30 seconds for Ib to stabilize.
- Break down voltage: -45V.



Measurement by Miyake

- Reported in 7 April meeting.
- Sensor is not thinned.
- Two 10 M resistors are put in series.
- Leak current <0.05 nA/strip and gradually increases in 0>Vb>-60 V.
- Breakdown voltage is 60 V.



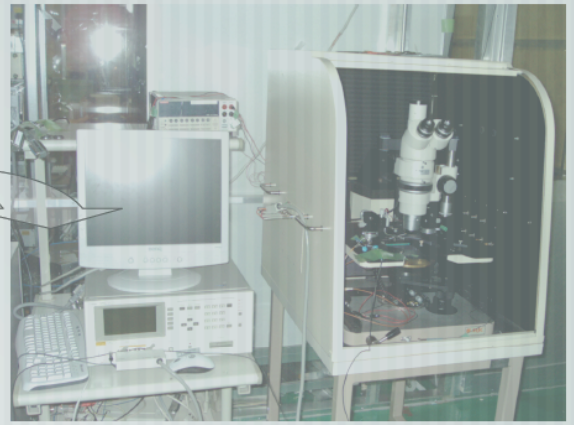
Summary on 25 Dec.

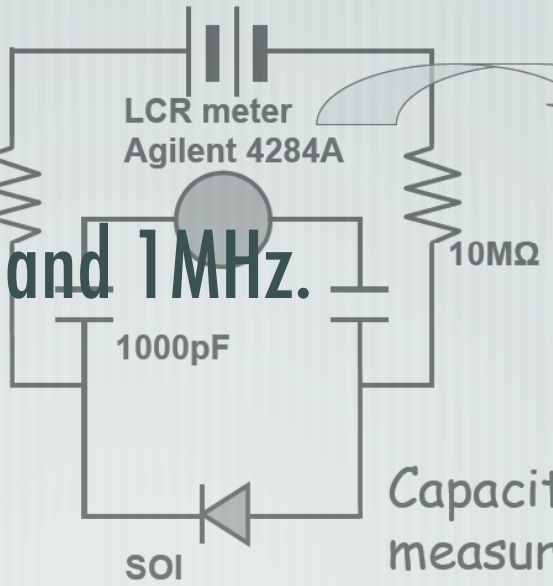
- Increase of leak current is not such bad as ATLAS SSD, reported by Kohriki (Dec. 2006)
- Breakdown voltage degrades from -60 V to -45 V after thinning.
- Capacitance measurement is to be done.
- I am still optimistic about thinning.
- We should try `*thinning before dicing*'.

26 Dec. measurement

- Set up is same as that of Miyake.
- Type 1 of the strip is measured.
- Amplitude=0.1 V
- Freq.=1k, 10k, 100k and 1MHz.

Test setup



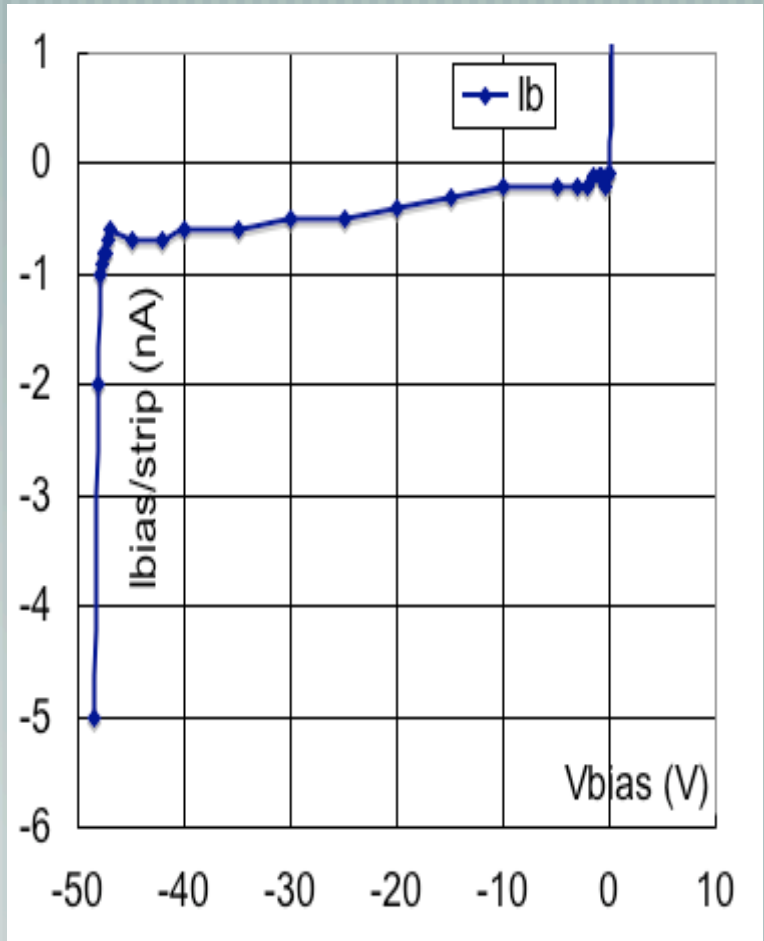


Capacitances are independently measured for type-5 and type-1

Freq. 10KHz
Level: 100mV

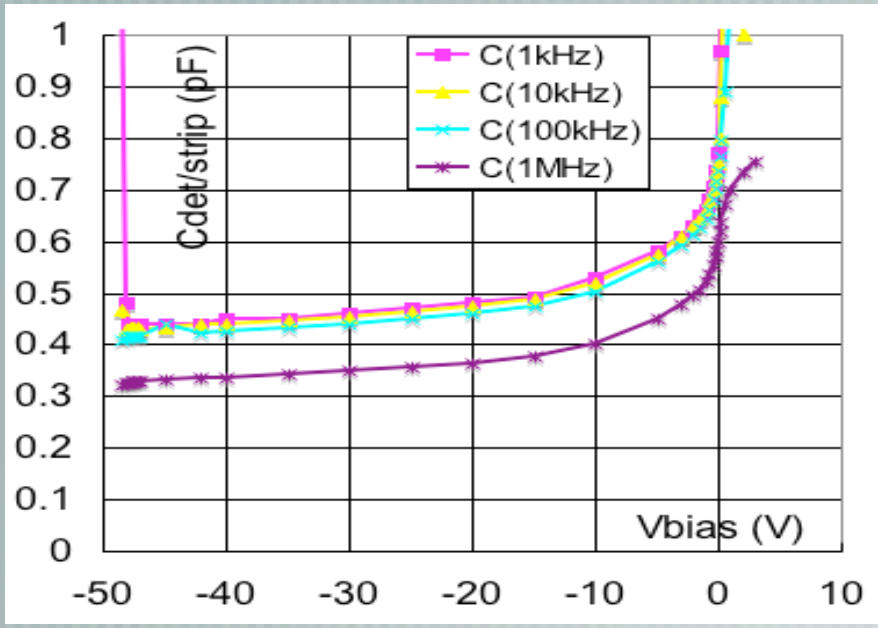
26 Dec. measurement (I-V)

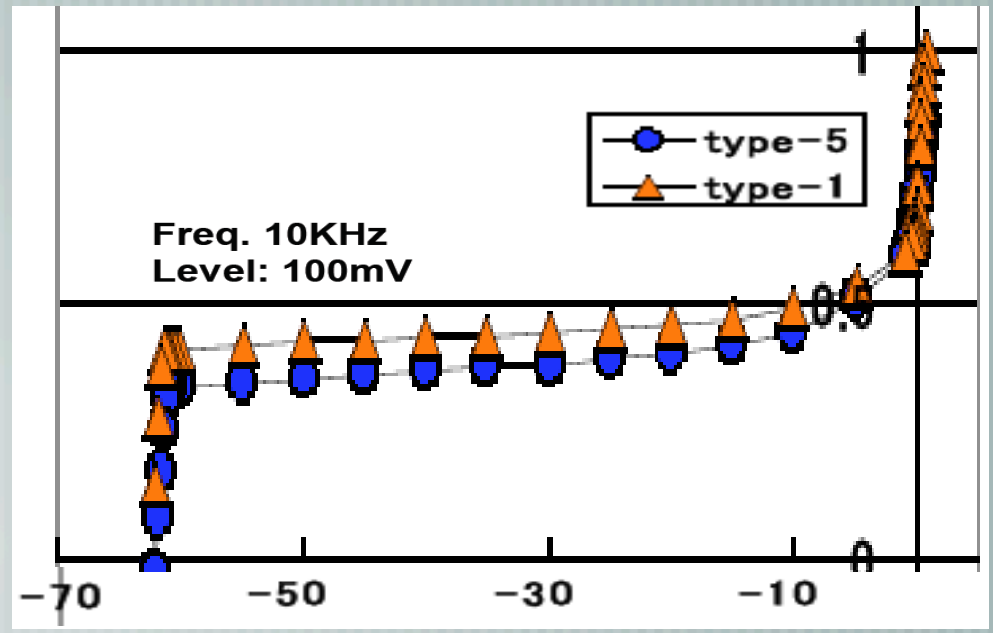
- The tendency and absolute value is much similar to that measured by Miyake.
- Breakdown voltage is -45 V.
- The small fluctuations are due to long damping time of the bias current.



26 Dec. measurement (C-V)

- The capacitance behavior is also same as that of Miyake.
- The capacitance is still decreasing at 50 V.
  - The 100 μm-t substrate is not fully depleted at 50 V.





Summary on 27 Dec.

- Breakdown voltage: 60 V before thinning, 45 V after thinning.
- Leak current does not increase: contrary to the 1000x increase observed in the thinned ATLAS strip detector.
  - Large amount of the current may flow to the detector edges.
  - Need confirmation.
- Detector capacitance at given bias voltage is same.
  - The substrate seems not fully depleted at the breakdown voltage.

Erratum in 5 Jan 2007

- I found the unit of I-V curve in Miyake's measurement is 1/10 than I thought. The I-V curves before and after the thinning are plotted here.
- In summary, the leak current increased significantly in the thinning process.