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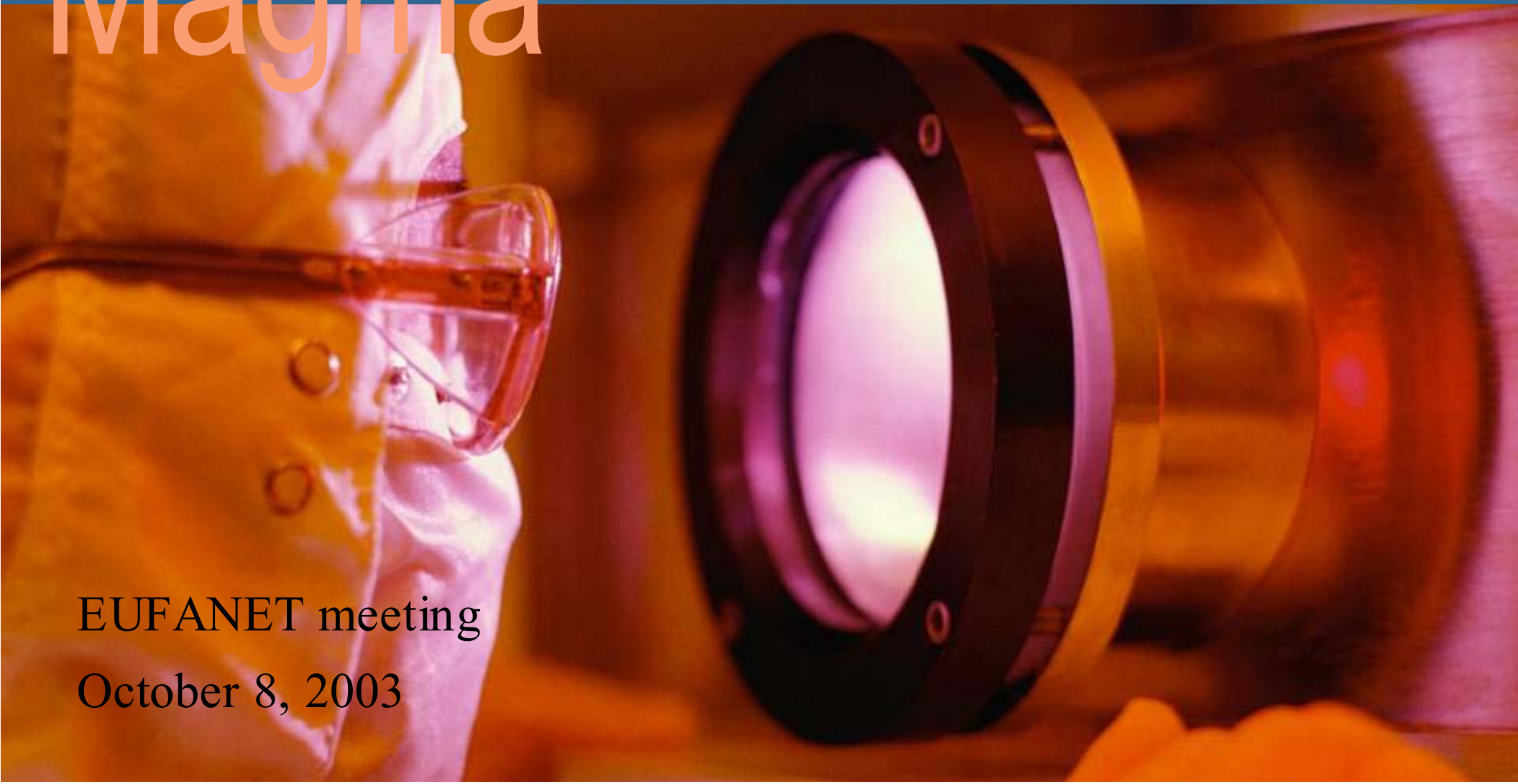
Magnetic Field Imaging

Magma



EUFANET meeting

October 8, 2003

Magnetic Field Imaging

- Imaging approaches that Neocera is presently using
  - SQUID
  - Fibre/SQUID
  - Magnetoresistance
- Application space
  - Boards – Packages (Flip-chip, stacked die, etc.) – ICs (wafers)
  - Shorts – Resistive Opens – Current leakage – Logic failures
  - Resolution from 10s of microns to sub-micron
  - Current sensitivity down to 100s of nA
  - Working distances from > 1mm to < 100 nm

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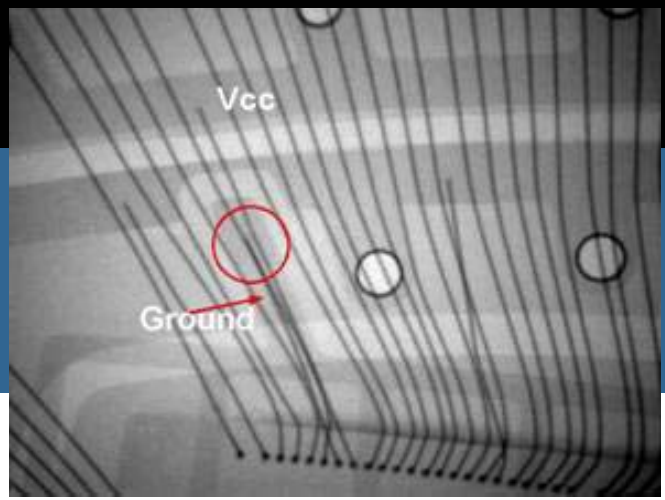
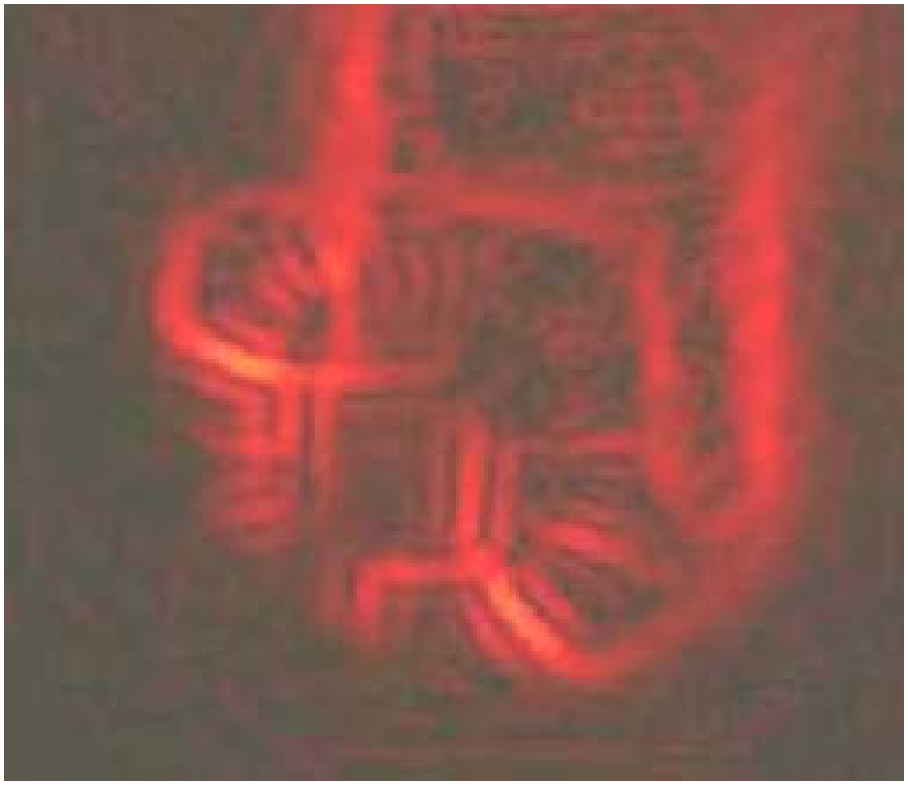
System Platform

SQUID at Package-Level (wire bond)



Good Part



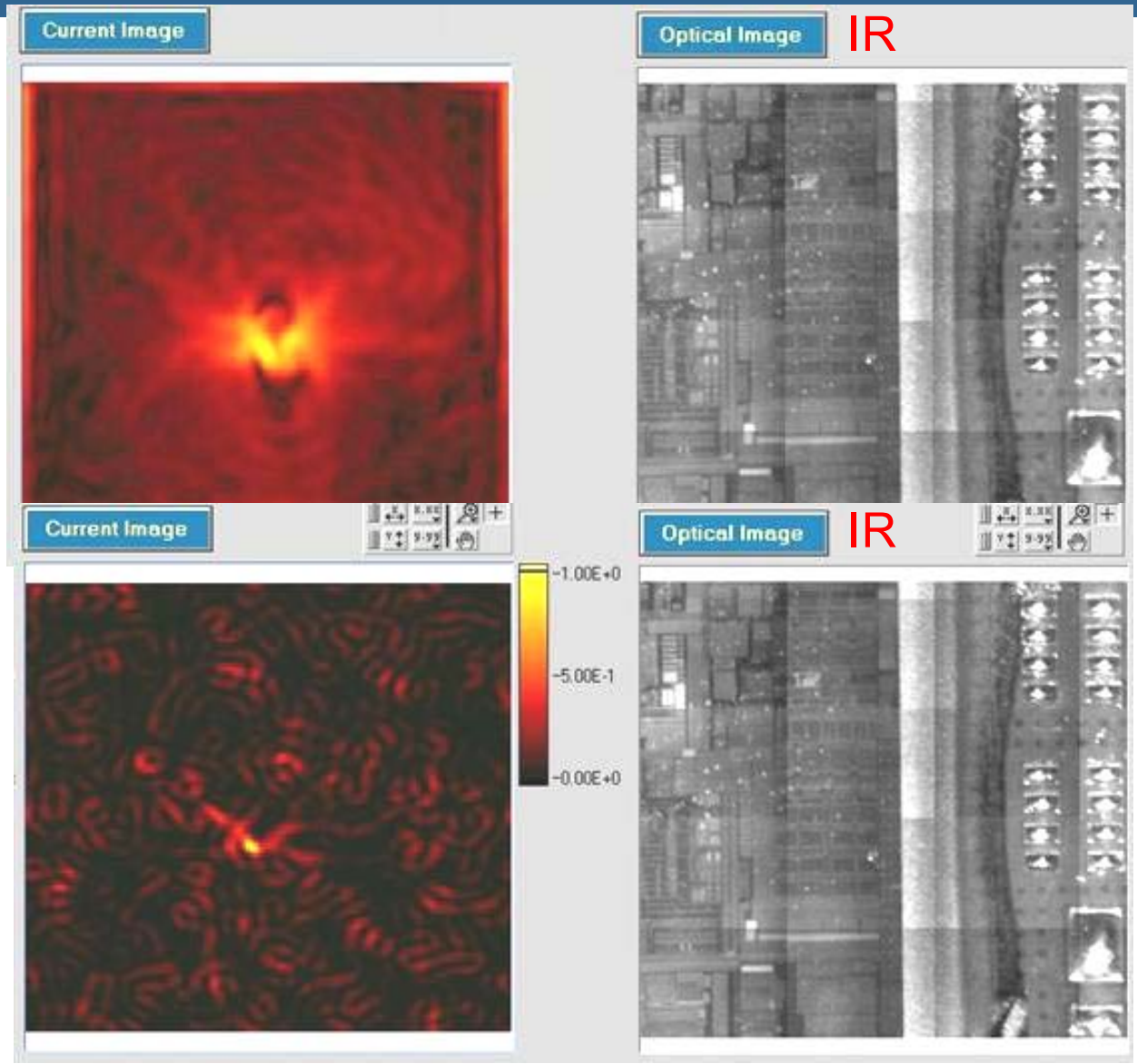
Bad Part

Current: 1 mA Distance: 1500 µm

SQUID at Package-Level (C4 bump)

Current: 125 µA
Distance: 450 µm

Current: 8.8 µA
Distance: 450 µm



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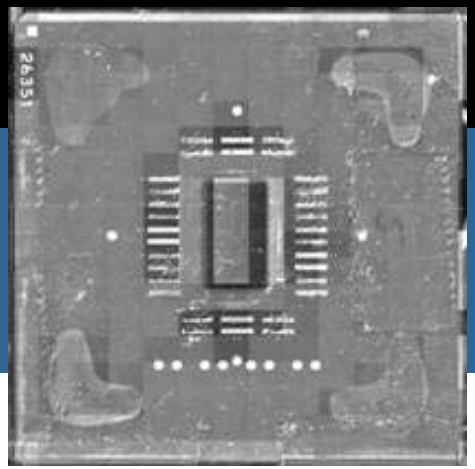
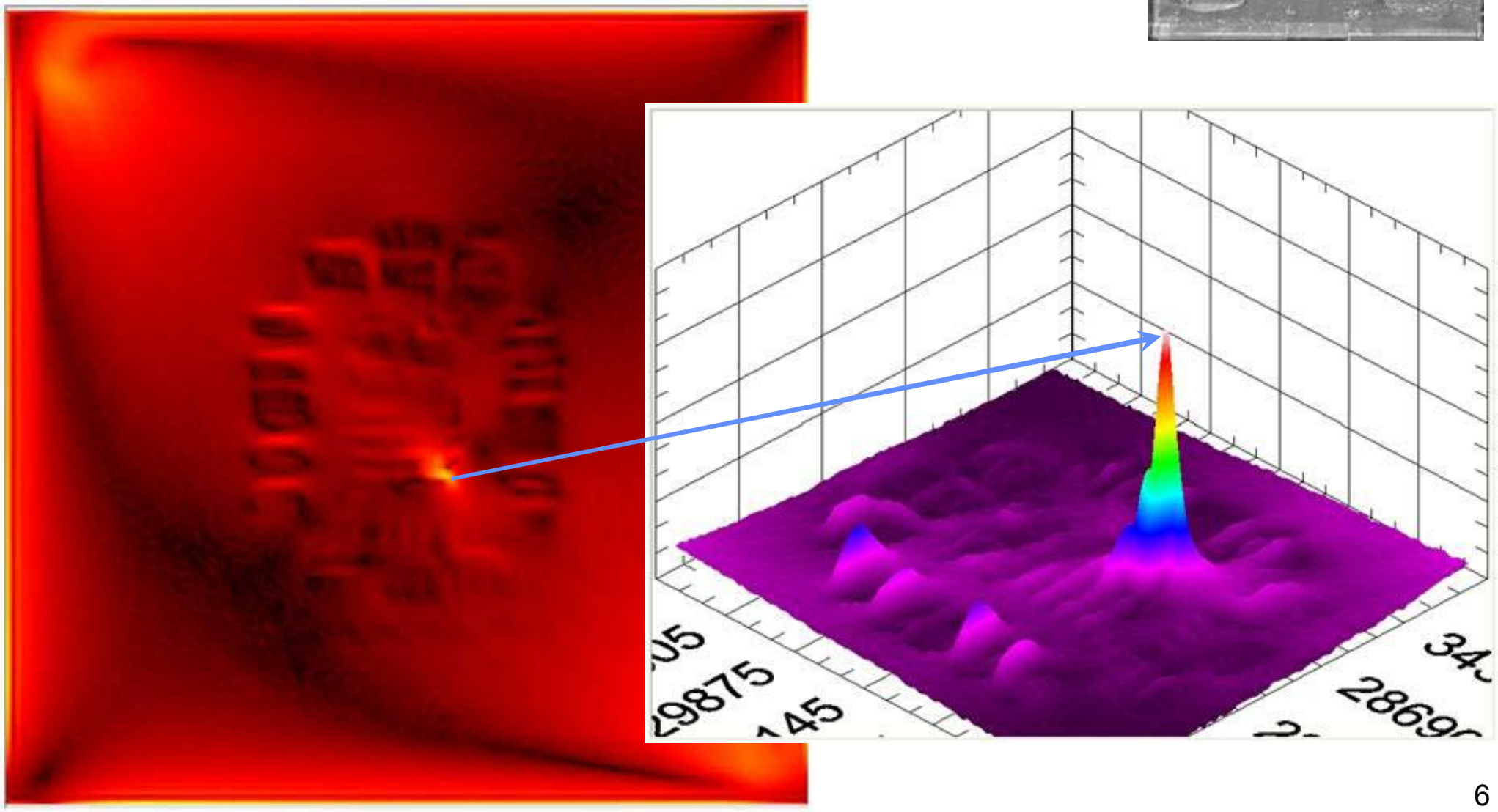
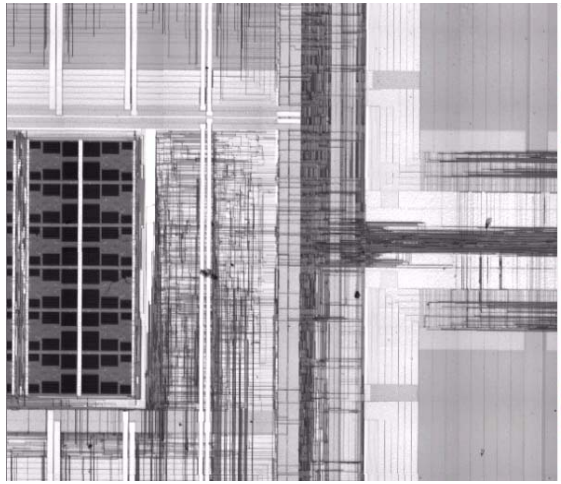
SQUID at Die-Level (back-side)





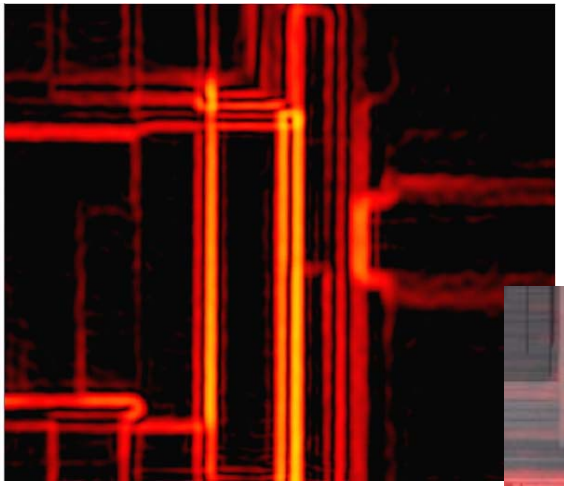
SQUID at Die-Level (front-side)

Optical

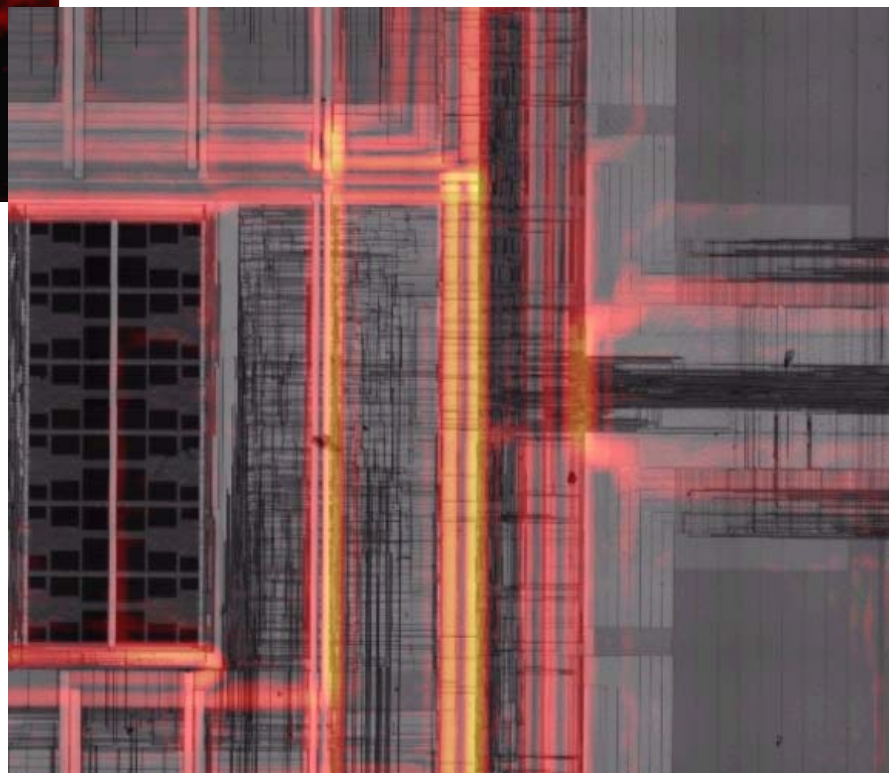


2.5 mm

Current Density

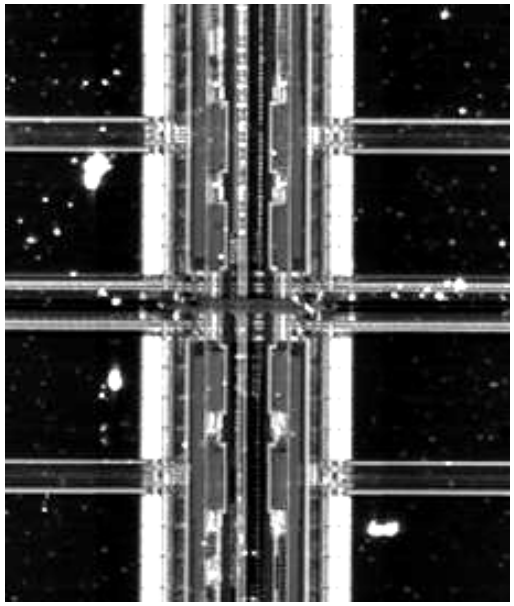


Overlay



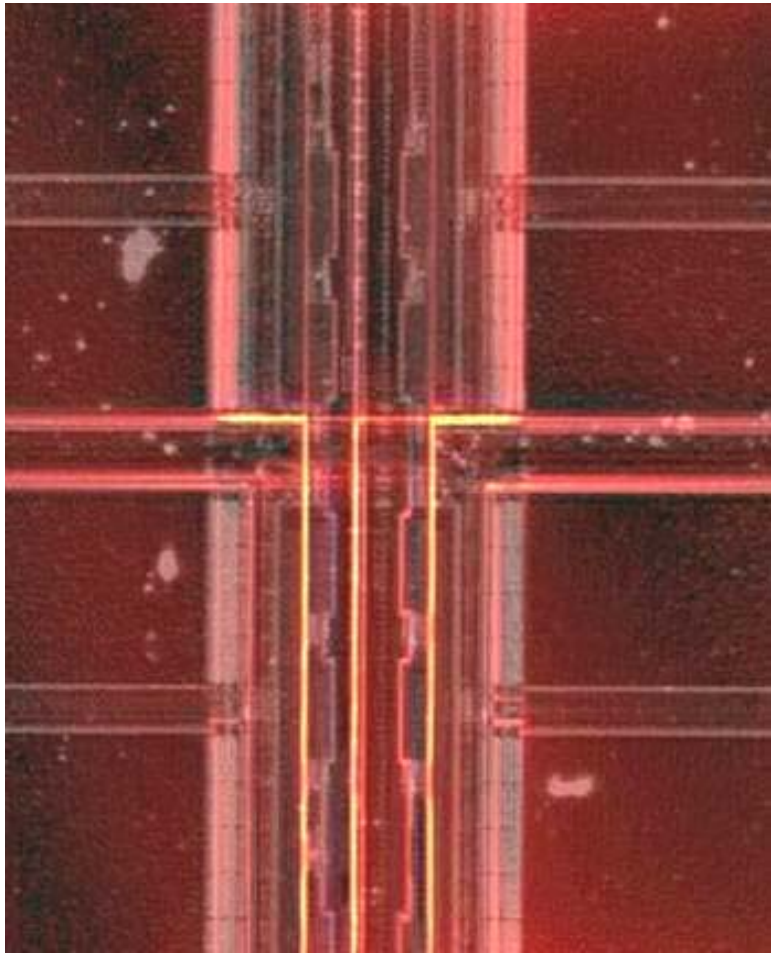
GMR at Die-Level (front-side)

Optical



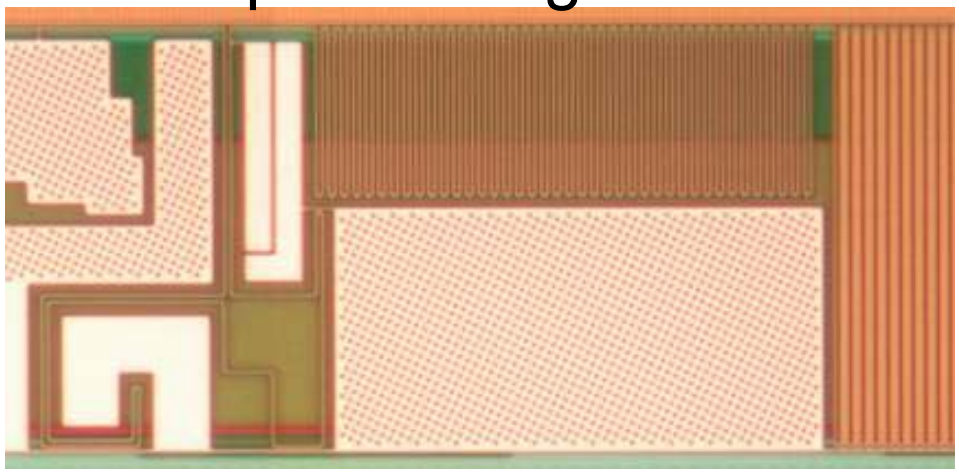
Current Density

Overlay

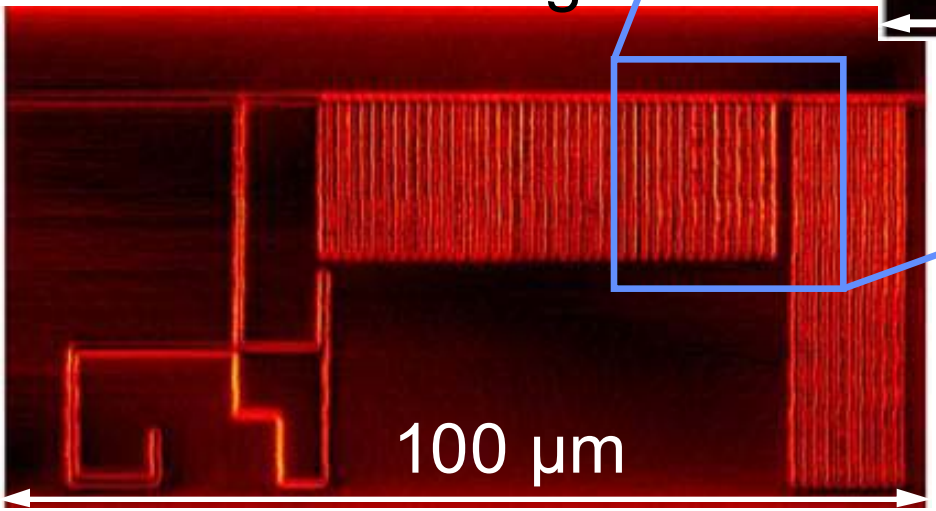


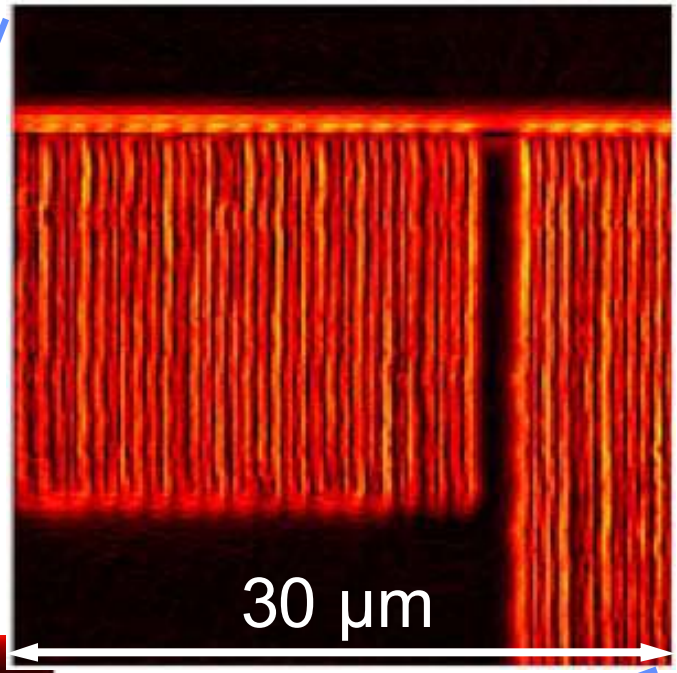
GMR at Die-Level (wafer part using probes)

Optical Image



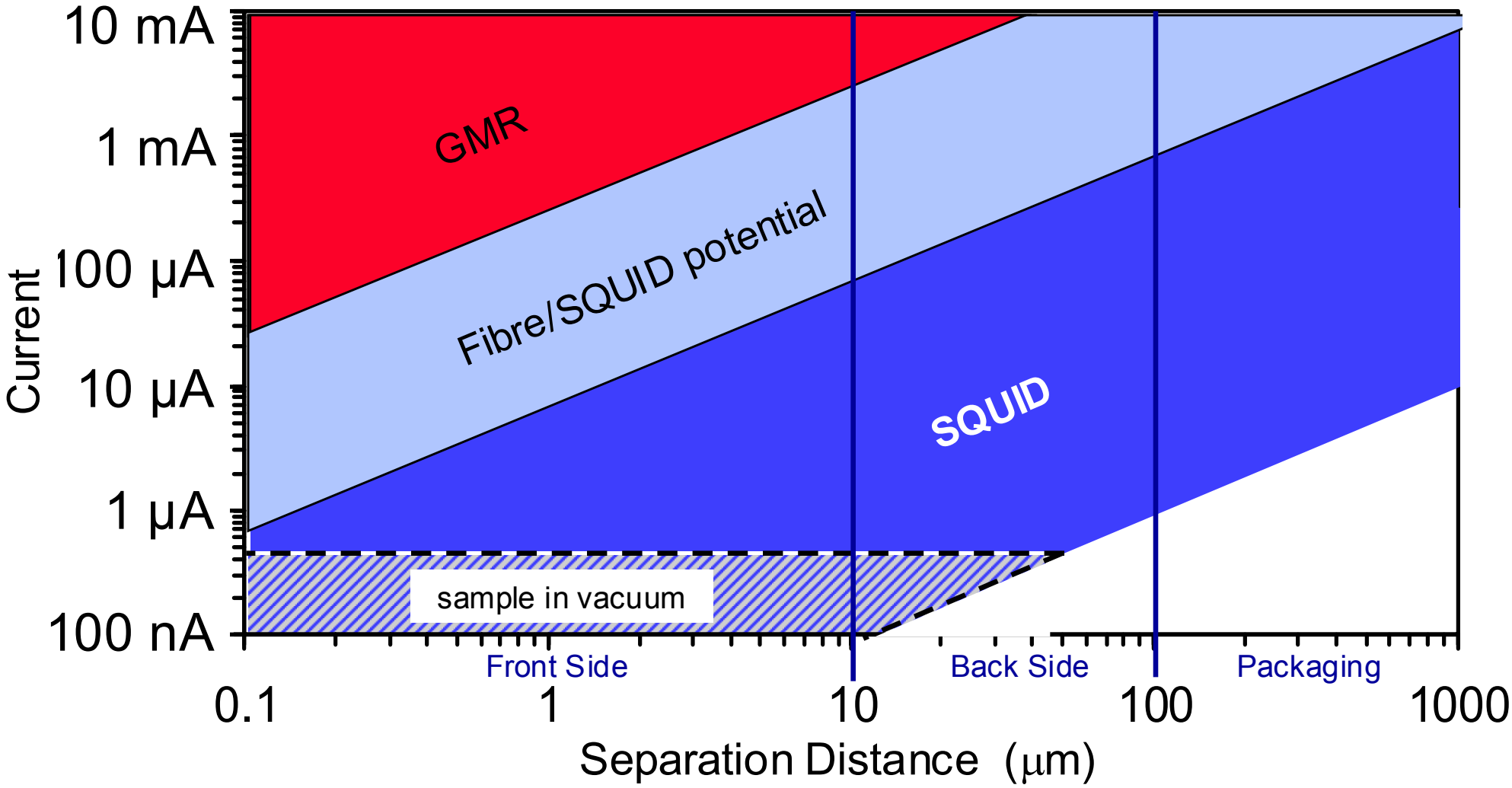
Current Image





0.3 µm lines with
0.3 µm spacing
I = 500 µA

Performance of Magnetic Sensors

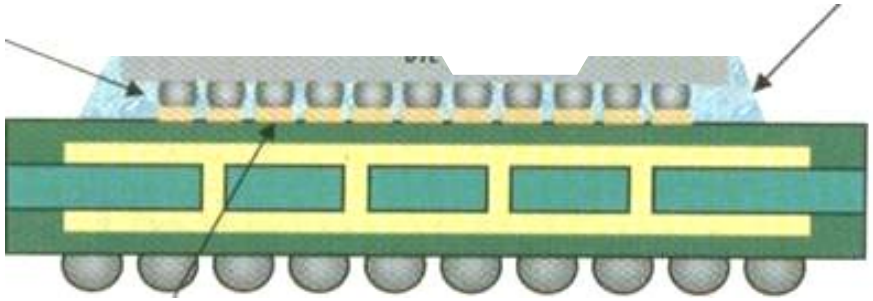


S/N = 10; TC = 3 ms

Comparison between sensors

- SQUID
  - Most sensitive
  - Ideal for large working distances ≥ 100 μm
  - Localize defects to 3 μm
- Magnetoresitive (GMR)
  - Less sensitive than SQUID
  - Good for short working distances of a few microns
  - Sub-micron resolution when very close
- Fibre/SQUID
  - Less sensitive than SQUID, but can be better than GMR
  - Good for short working distances of a few microns
  - Natural high aspect ratio of tip is good for working in cavities
  - Sub-micron resolution when very close

Implementation Model



- Coarse scan with SQUID to isolate component
- If defect is in the die, then thin the die and fine scan with SQUID
- Locally open a cavity (laser; FIB)
- Scan with magnetoresistive sensor or fibre/SQUID.