NETWORK of EXCELLENCE
DESIGN FOR MICRO & NANO MANUFACTURE
PATENT (DfMM)

DfMM NoE PATENT

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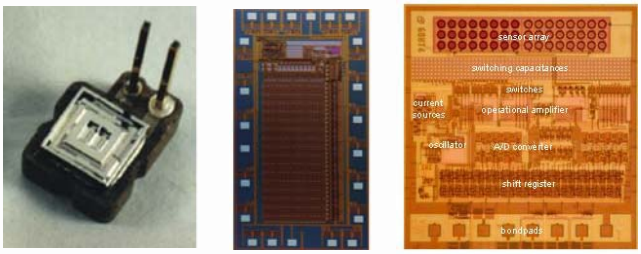
Reliability of MOEMS in harsh conditions

Objectives

• MOEMS working in harsh conditions arising from the environment (space, corrosive gas, high pressure, high temperature T>150°C, liquids, shocks,…) or from their operation (high current density, large deflections, high voltages,…) are severely prone to reliability issues.
• As MOEMS applications at “harsh” environment are steadily increasing it’s essential to focus the expertise of the Patent-DfMM partners in a first step in order to collect information on reliability issues and on very application specific test approaches existing at each lab.
• In the current project (phase I), the team is working on following activities: hardware setup (BUTE, CSL), design of test structures (IEF, IMS), packaging issues (IMS).

Partners involved and roles

• IEF – Reliability of high current density actuators
• IMS – Coordinator, Reliability of high temperature devices
• BUTE – Thermal measurements on high temperature and high current density MEMS
• IMT – Reliability in salt mist and damp heat
• CSL – Reliability in space
• IXL – Reliability of high voltage MEMS
• IZMM – Reliability in liquids



Test devices: micro pumps (source: IZMM), HT-EEPROM (source: IMS), integrated surface micromachined pressure sensor on SOI (source: IMS)

Summary of results

• A final report of more than 70 pages has been compiled containing information obtained from experiences at the partners labs, from literature research and from experiments like e.g.:
• Electromigration in copper microcoils as parts of electromagnetic actuators,
• Investigation of assembly materials for integrated MEMS for operation at temperatures up to 300°C.

Offer to industry

• Advisory service for design, packaging and test of MOEMS in harsh conditions.
• Development of SOI-devices for high temperature applications.
• Conduction of tests under harsh conditions.

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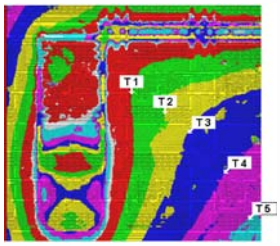
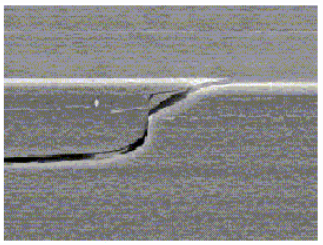
Project status

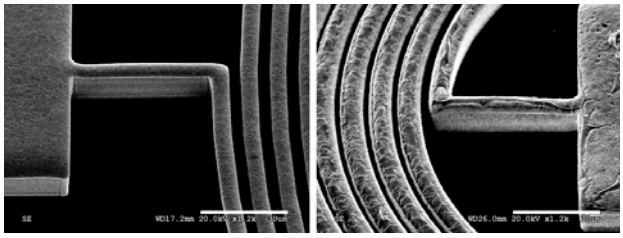
Phase 1 completed, April 2005



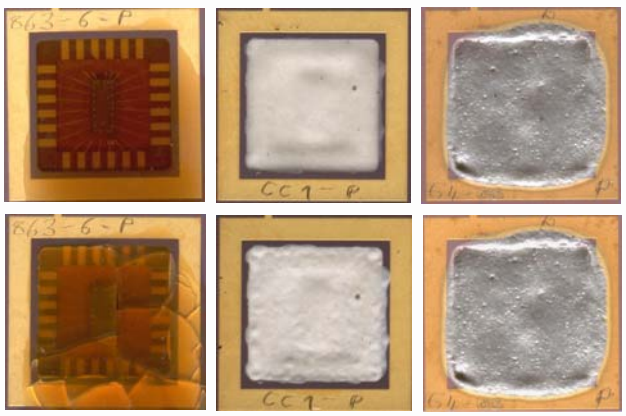
Liquid Crystal Thermal Mapping (difference between adjacent isotherms is 0.16°C) (source: BUTE)



Cracks in single crystal silicon support beams caused by vibrations induced by a launch simulation (source: CSL)



Comparison between two identical on-wafer Cu-microcoils: an original one (left) and one after high current density stress (right) (source: IEF)



Investigation of appropriate material for die bonding and glob top (samples under test after 100 and 300 thermal cycles) (source: IMS)