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Design, Fabrication, and Characterization of Dense and Large-stand-Off Compressible MicroInterconnects (CMIs) for Advanced Testing and Socket System Application

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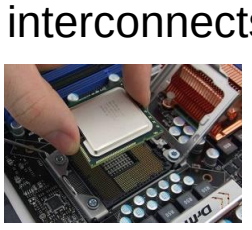
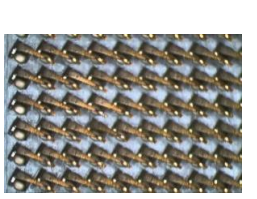
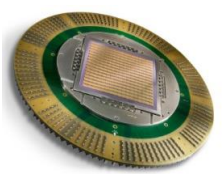
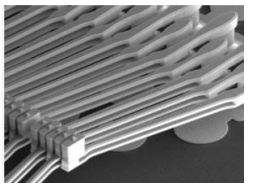
Introduction

- Commercial applications of mechanically compliant interconnects

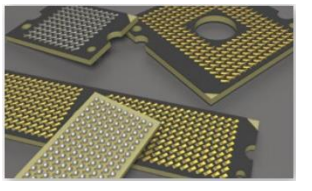
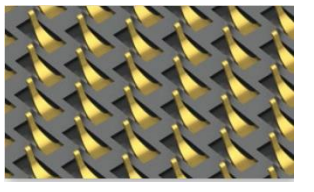




Intel Core™ i7 Processor and Opteron™ Processor with Land Grid Array (LGA) Socket

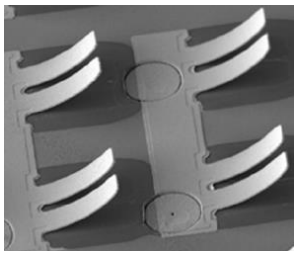
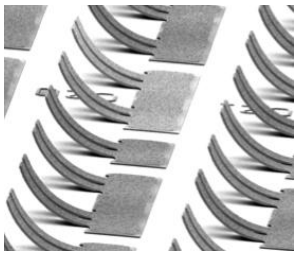



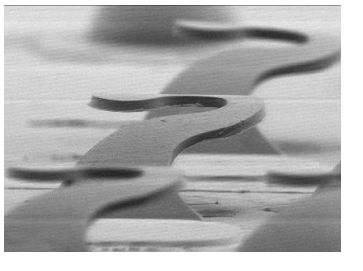
FormFactor Probe Cards

Samtec Micro-Interposer

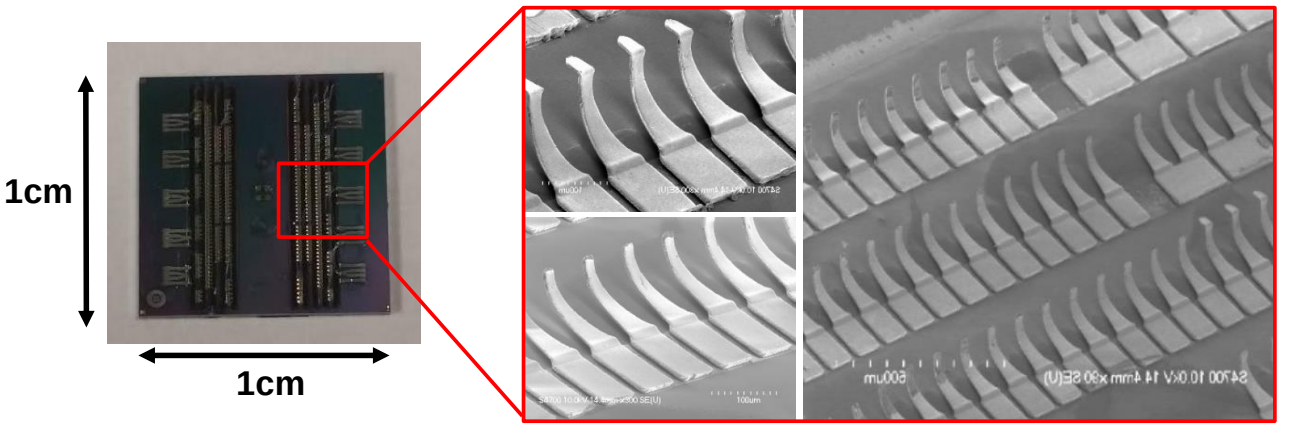
Challenges with Current Efforts



- Non-standard fabrication process
- Limited compliance
- Rolling effect
- Small elastic range of motion
- Limitation on interconnects design

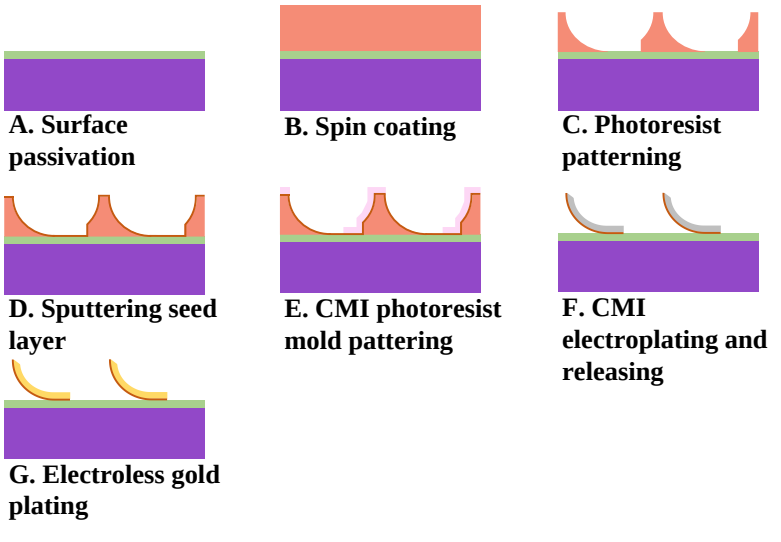
Gold Plated NiW Compressible MicroInterconnects (CMIs)

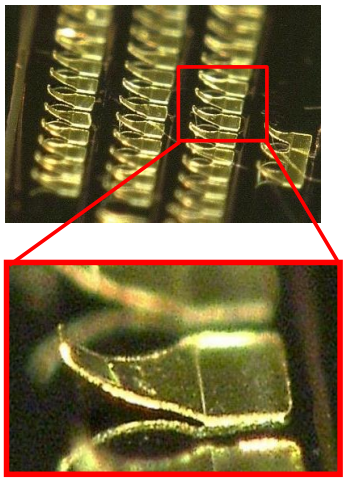


Batch fabricated CMIs on a silicon substrate (80 μm height, 150 μm in-line pitch)

- **Lithographic-defined**, **CMOS compatible** fabrication process
- **Pressure-based** and **non-permanent** contact
- **High-degree of freedom** in interconnect design
  (height, length, thickness, top-view design, and side-view geometry)
- **Large elastic range of motion**
  (45 μm elastic deformation from 75 μm height CMI; 60% of its total height)
- **Large height** and **Highly scalable pitch**
  (up to 100 μm height and down to 40 μm pitch has been demonstrated)
- **Multi-height & multi-pitch fabrication**

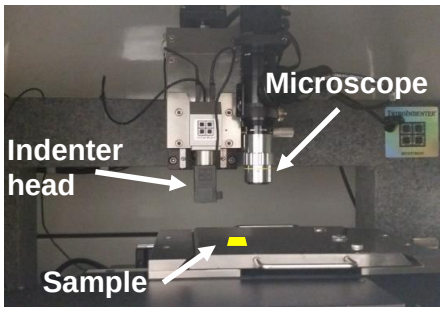
Fabrication Process Flow



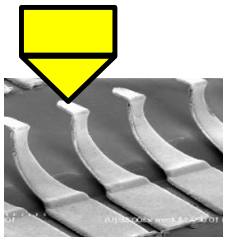


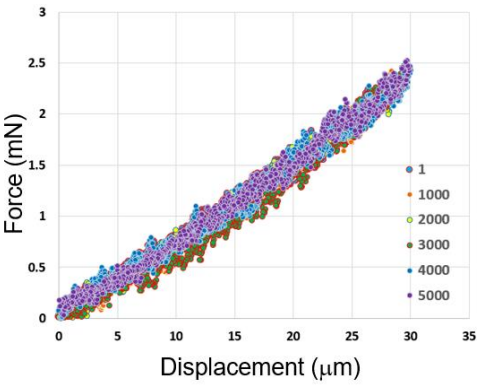
3D microscope image of the fabricated CMIs

Mechanical Characterization



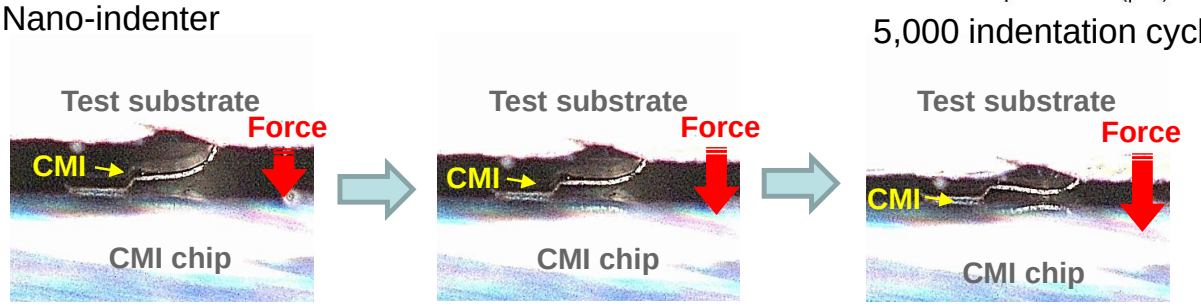
Indenter Tip





Nano-indenter

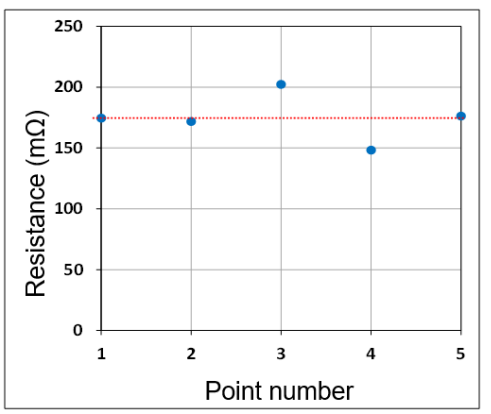
5,000 indentation cycles



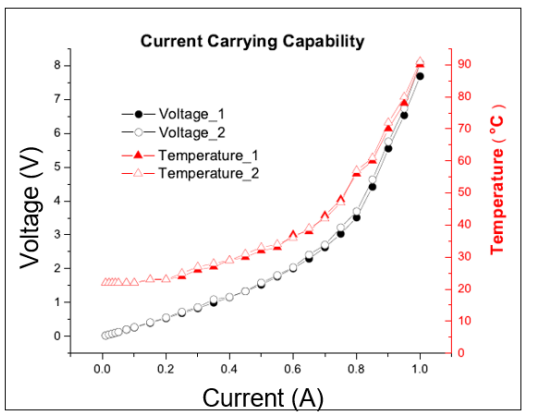
Cross section images of flip-chip bonded CMI

- NiW yield strength: 1.93 GPa (Cu has 136 MPa)
- Reliable compliance (≈ 12.24 mm/N) of 70 μm height CMI during **5,000 indentation cycles**
- Compliance range from 2.63 mm/N to 59.13 mm/N has been demonstrated

Electrical Characterization



4-point resistance of CMIs
(Average resistance: 176.3 mΩ)



Current Carrying Capability: Up to 1A

Conclusion

- Highly flexible NiW CMIs are batch-fabricated using **simple and standard CMOS compatible processes**
- **High degree of freedom in interconnect design** enables an ability to reasonably control mechanical and electrical properties of CMI
- This can allow CMIs to be used in various fields of application including **testing and socket system application**