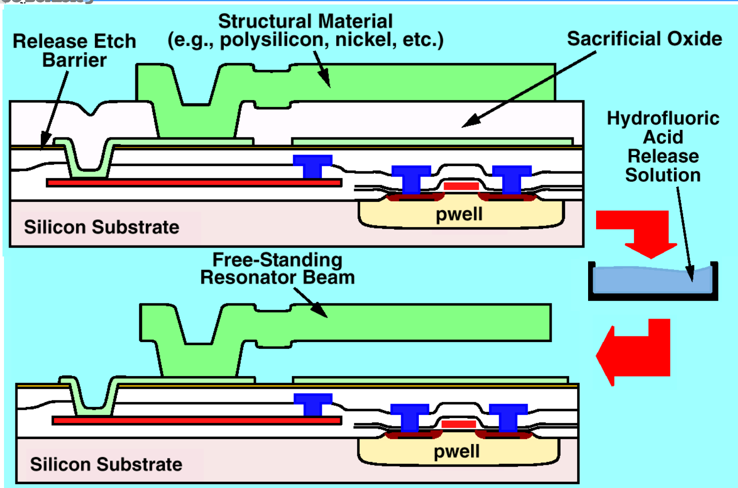
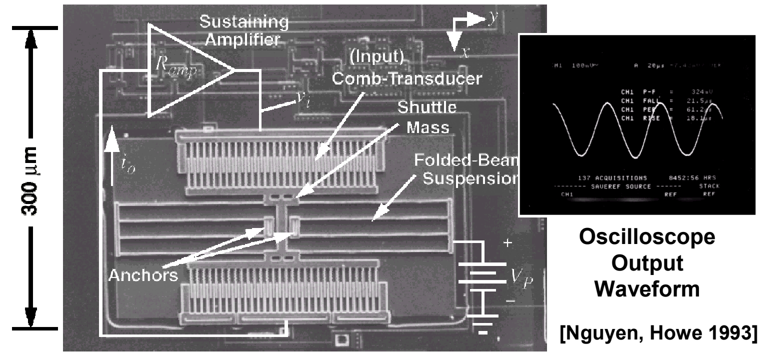
Surface Micromachining



- Fabrication steps compatible with planar IC processing

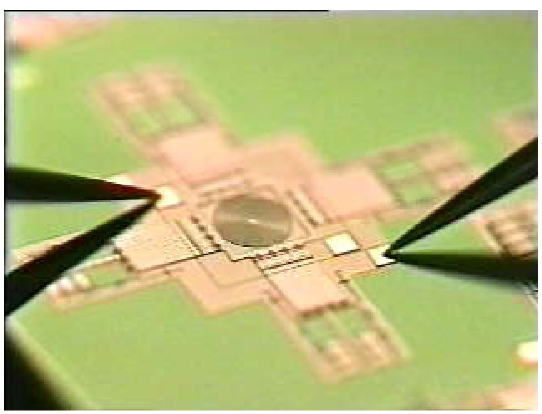
Single-Chip Ckt/MEMS Integration

- Completely monolithic, low phase noise, high-Q oscillator (effectively, an integrated crystal oscillator)



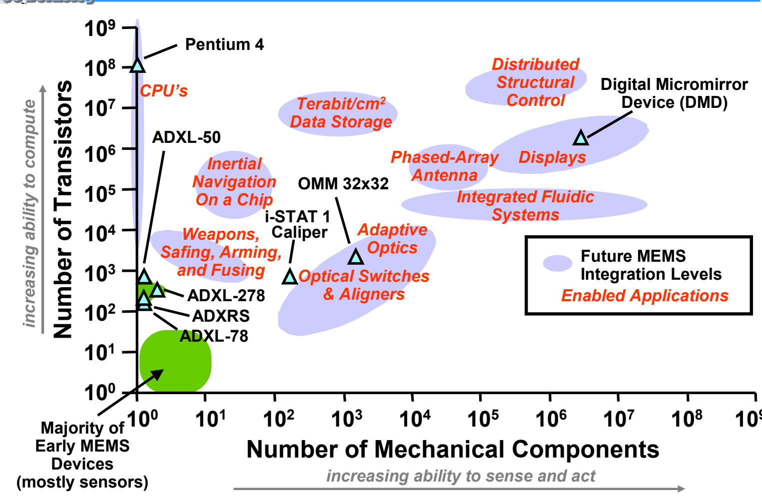
- To allow the use of >600°C processing temperatures, tungsten (instead of aluminum) is used for metallization

3D Direct-Assembled Tunable L



[Ming Wu, UCLA]

Technology Trend and Roadmap for MEMS



Example: Micromechanical Accelerometer

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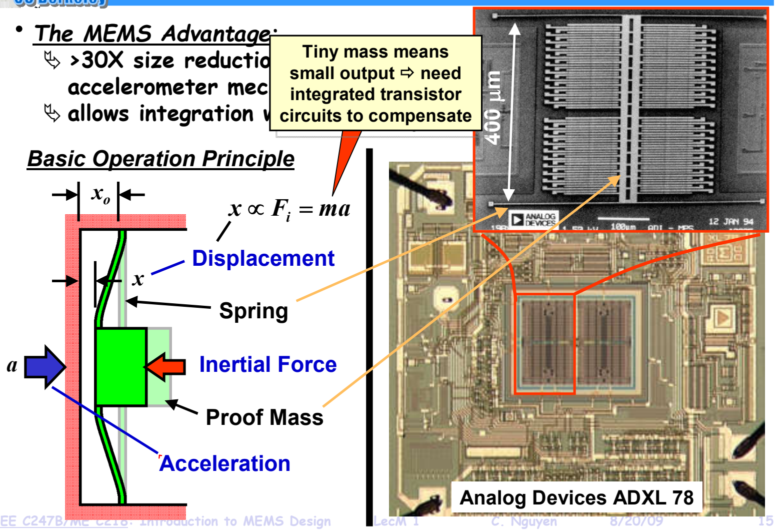
- *The MEMS Advantage*:
  - >30X size reductio[n] … accelerometer mec[hanical element]
  - allows integration w[ith] …

Tiny mass means small output ⇨ need integrated transistor circuits to compensate

Basic Operation Principle



Technology Trend and Roadmap for MEMS

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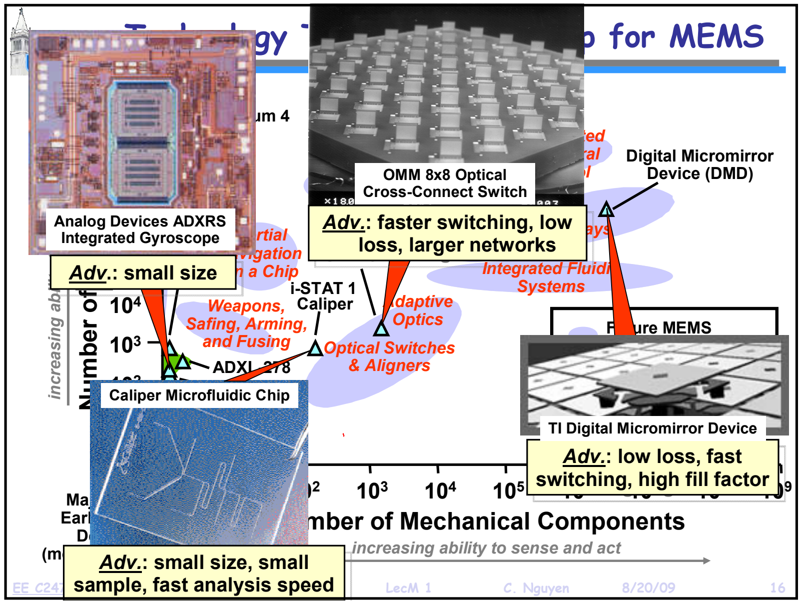

Technology Trend and Roadmap for MEMS

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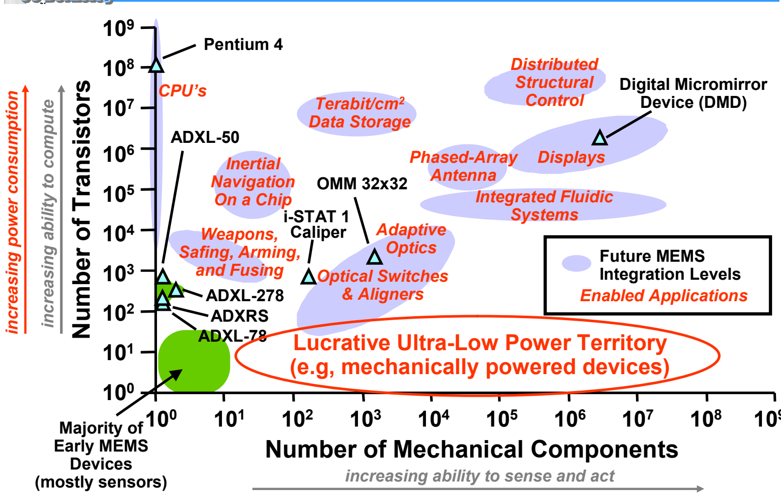

Benefits of Size Reduction: MEMS

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- Benefits of size reduction clear for IC's in elect. domain
  - size reduction ⇨ speed, low power, complexity, economy
- MEMS: enables a similar concept, but …

MEMS extends the benefits of size reduction *beyond* the electrical domain

Performance enhancements for application domains beyond those satisfied by electronics in the same general categories

Speed	⇨	Frequency ↑, Thermal Time Const. ↓
Power Consumption	⇨	Actuation Energy ↓, Heating Power ↓
Complexity	⇨	Integration Density ↑, Functionality ↑
Economy	⇨	Batch Fab. Pot. ↑ (esp. for packaging)
Robustness	⇨	g-Force Resilience ↑