

MicroFabrication Processes for Ion Trap Technology

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Micromachining allows fabrication of structures/components having a wide range of length scales, complexities and functionalities

Si Deep Etch

- aspect ratios >40:1
- depths to 2mm
- submicron features
- multiple depths
- high precision

Conformal Coatings

- Metals, Dielectrics, Organics
- Plating, ALD, vapor processes

Advanced Lithography

- Ebeam, Projection, Contact
- Resist coating over topology

Thick Coatings

- Metals, Dielectrics, Organics
- Plating, CVD, vapor processes

Integration, Microassembly, Packaging

- Integration mechanical, optical, RF, magnetics
- Microassembly w/ precision placement, alignment
- Packaging w/ hermetic feedthroughs

Wafer and Chip Bonding

- Au, In, TLP, Anodic processes
- Underfill process

3D Microstructures

- Si and glass
- Reflow, Grayscale processes

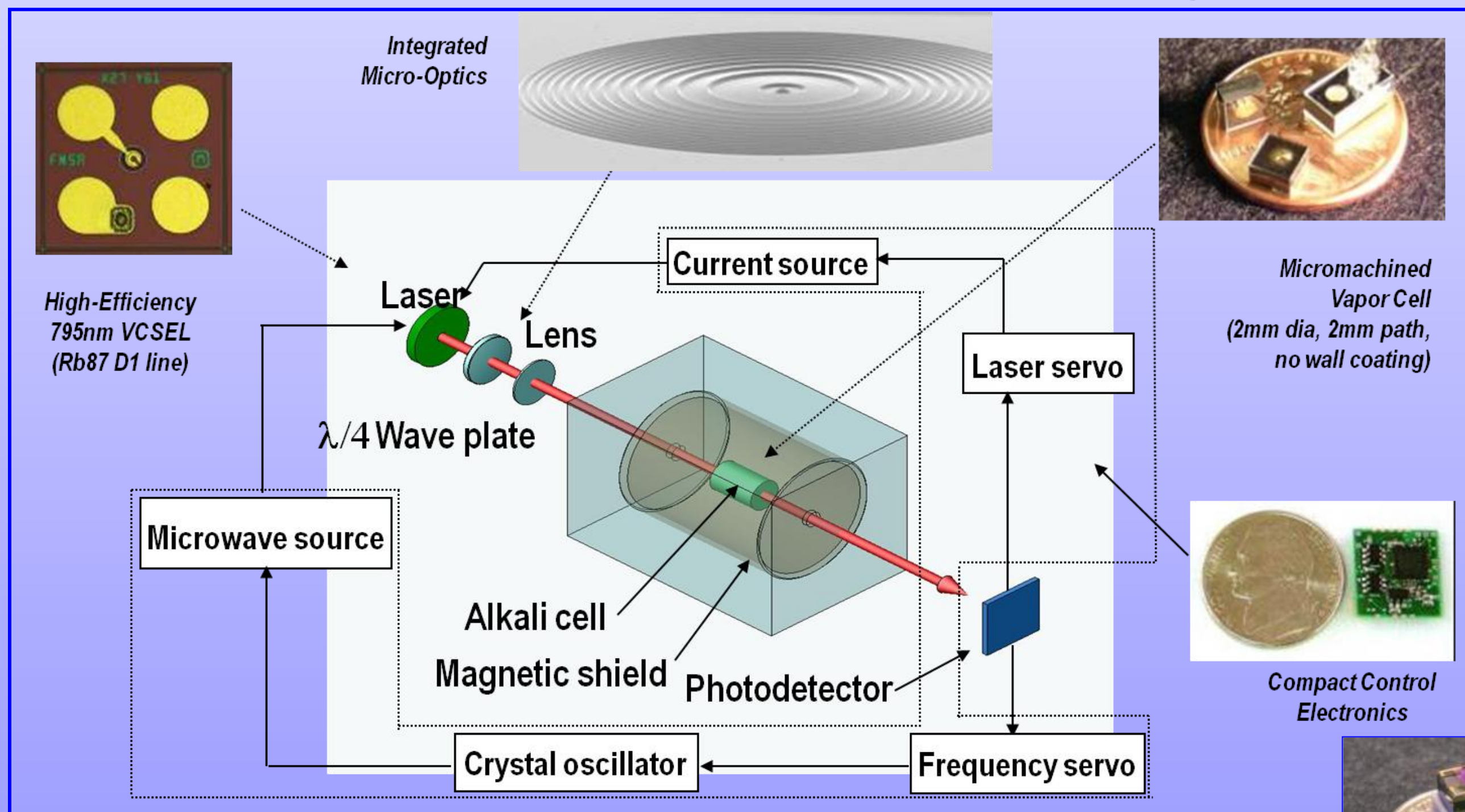
Systems Enabled by MicroAssembly/MicroIntegration

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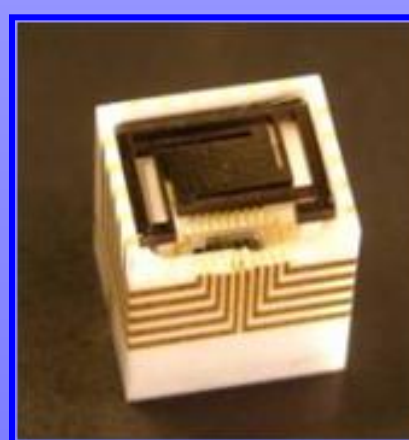
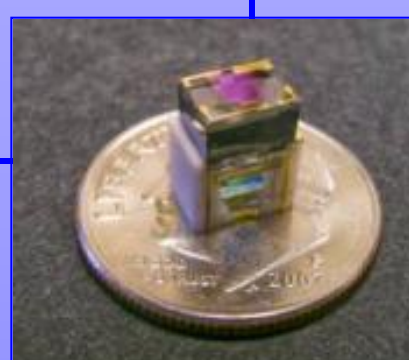
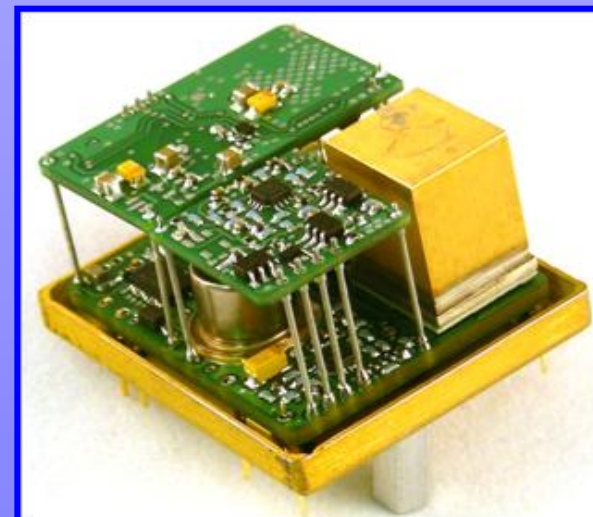
MicroAssembly/MicroIntegration enables compact, high-performance systems

Chip Scale Atom Clock (CSAC Program)



- Rb vapor cell, laser, quarter wave plate, lens, photodetector, heater, shielding electronics
 - integrated into package 1cc
 - power consumption <30mW
- Allan Deviation 1×10^{-11} in 24 hours
- planning for product transition

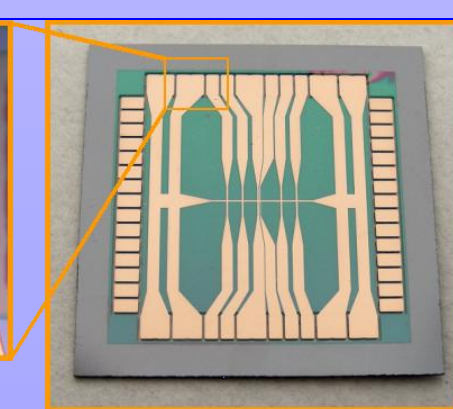
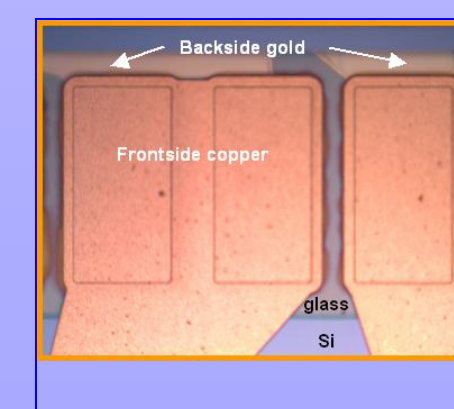
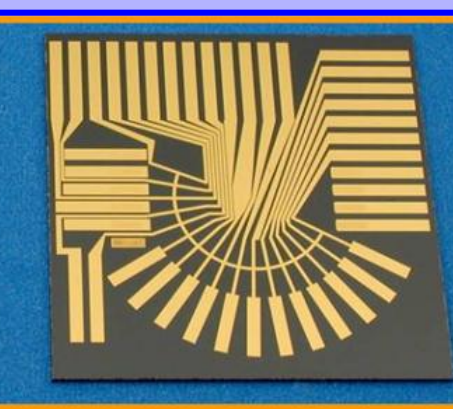
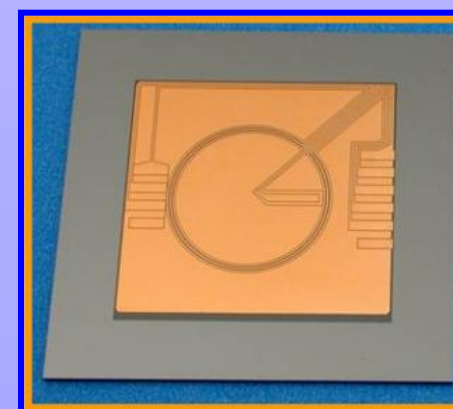
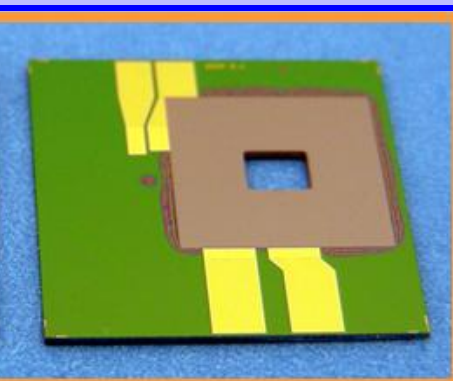
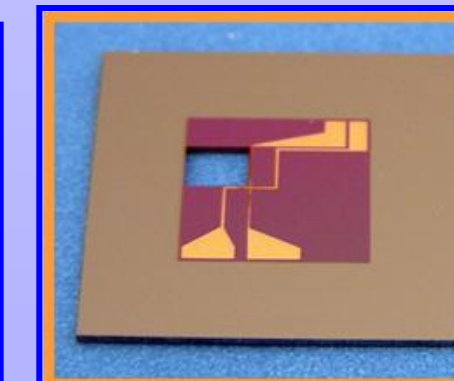
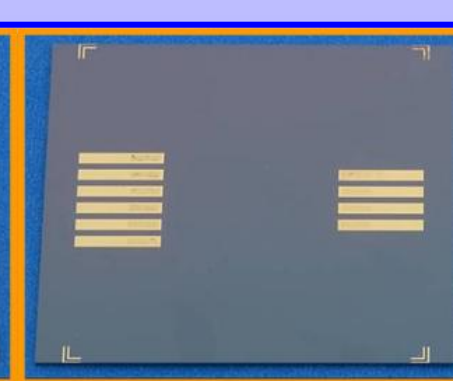
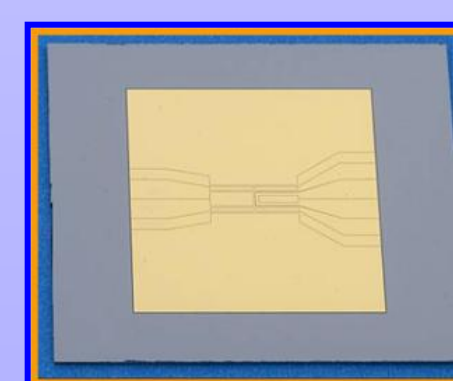
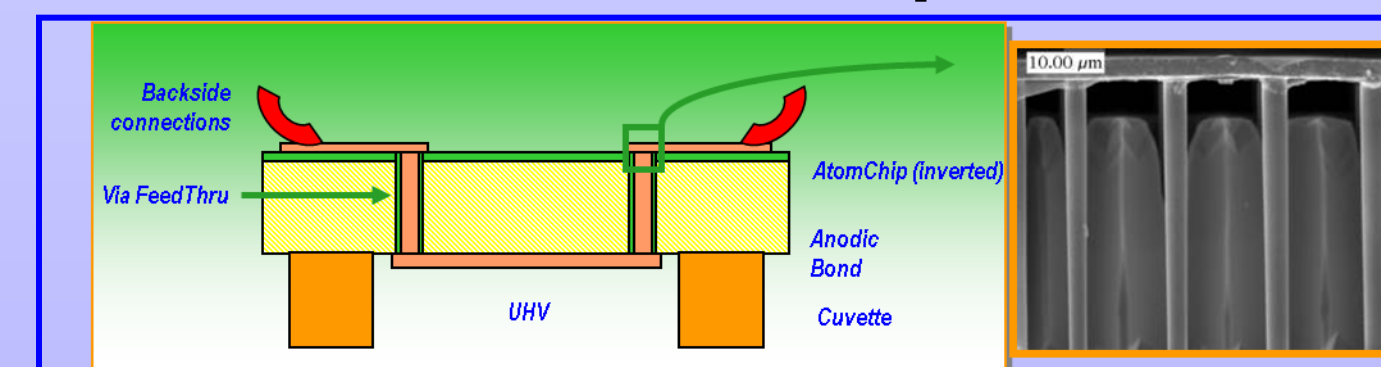
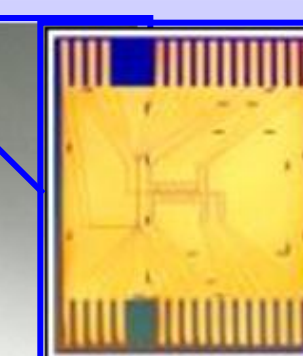
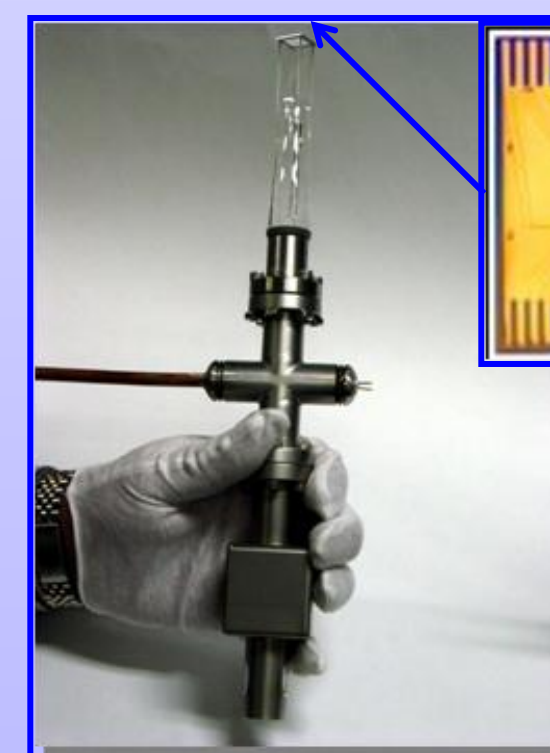
CSAC realized using micromachining and microassembly/microintegration



Cold Atom Systems (gBECi Program, supporting UofC)

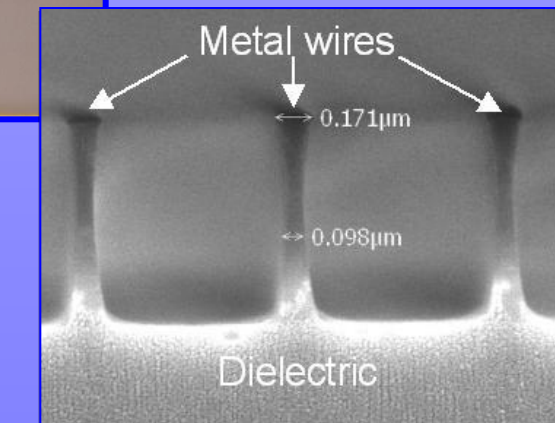
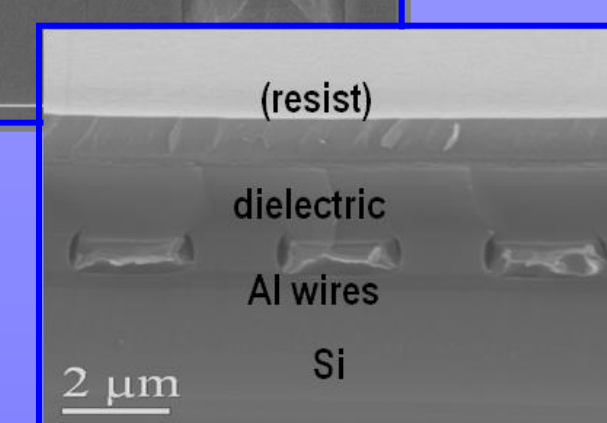
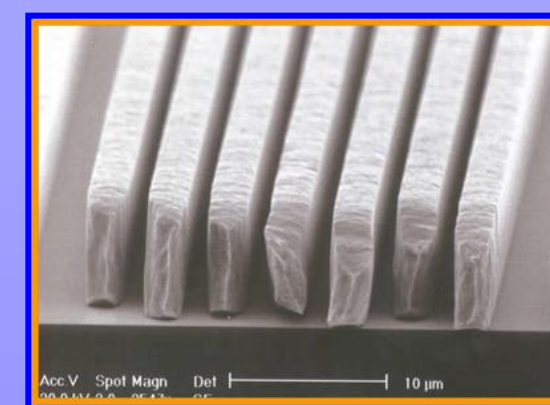
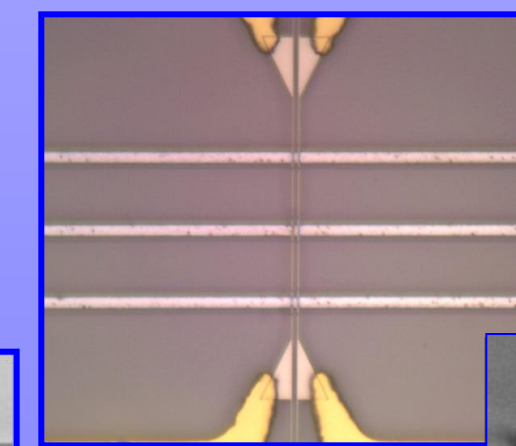
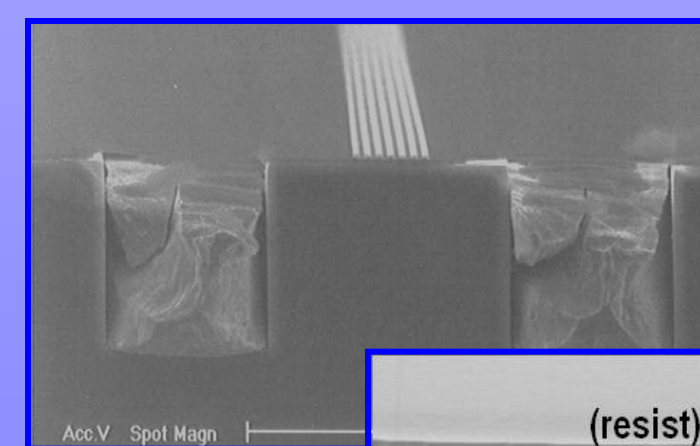
Atom Chips

- chip as one side of vacuum cell
- UHV hermetic feedthrus
- integrated optical windows
- used in BEC experiments

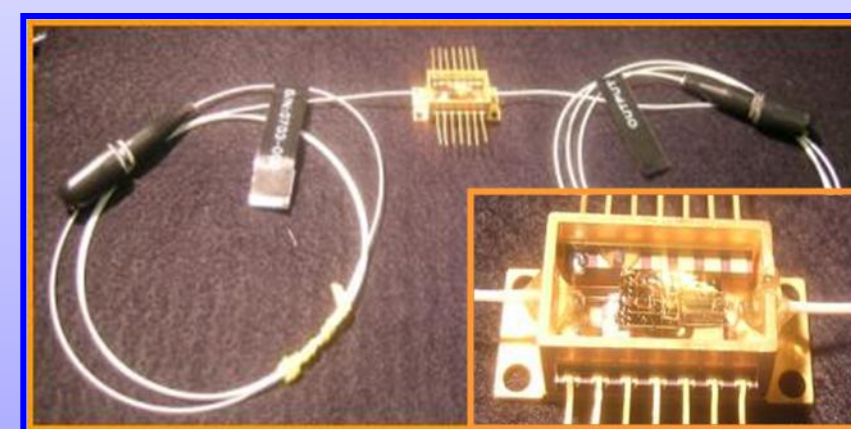
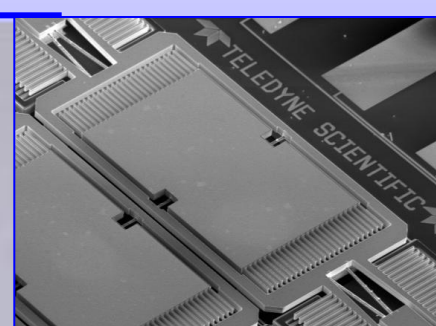
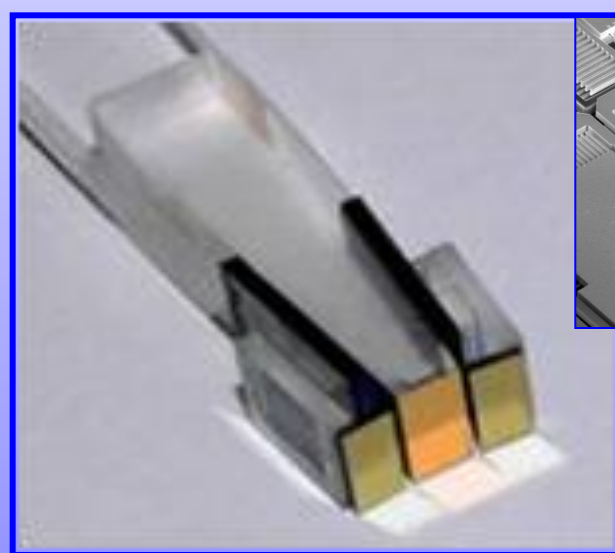
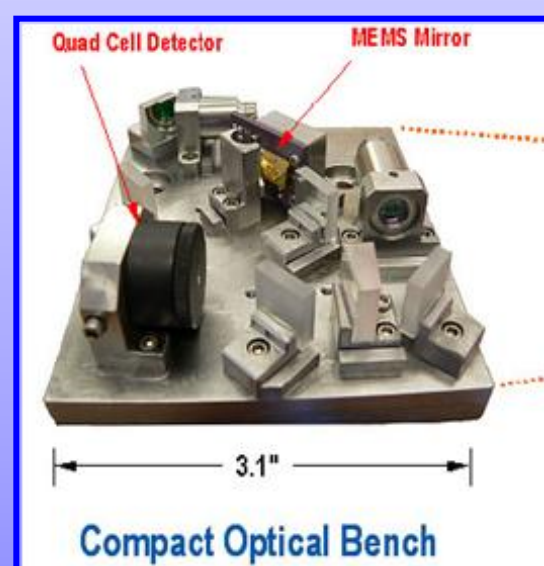


Advanced Atom Chip Structures

- high-aspect-ratio metalizations
- multilayer/multiscale metalizations
- submicron, bridging wires



Photonics/Optics



Fiber Optical Shutter

- designed for cold atom uses
- IL -2dB, ISO -70dB, RL -50dB
- switching times <math><50\text{usec}</math>
- no mechanical noise

- free-space optical communication
- MEMS optical crossbar switch

Compact cold atom system based on micromachined atom chips