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# **Fabrication of High Frequency Single Crystal Silicon Micromechanical Resonators**

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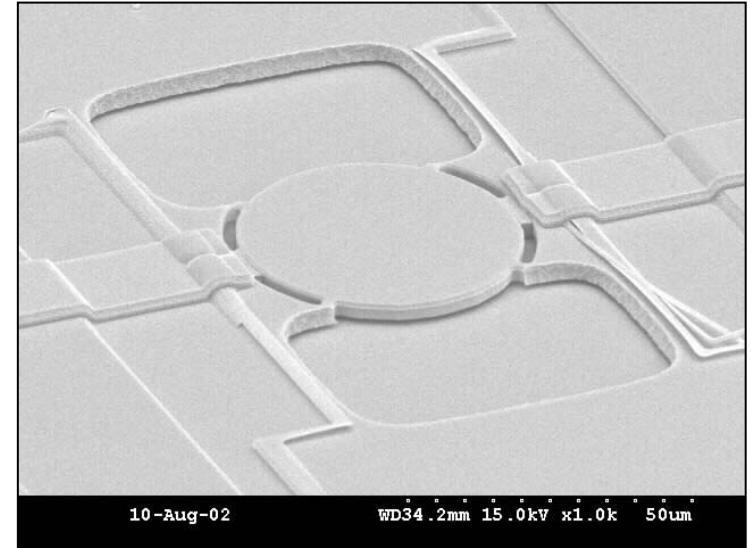
*School of Electrical and Computer Engineering*

*Georgia Institute of Technology*





# High Frequency SCS MEMS Resonators

## □ Unique Features

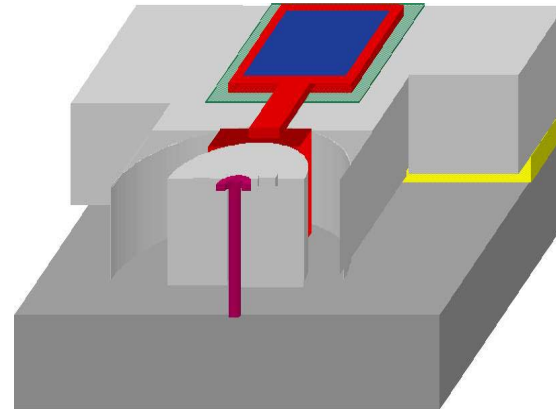
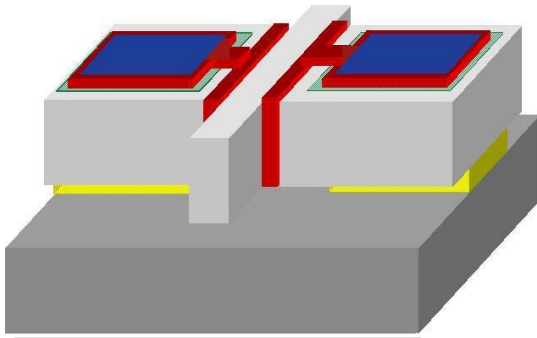
- **Single Crystal Silicon** resonating element
  - Potentially lower internal friction and **higher Q**
  - Process independence
- Ultra-thin capacitive gaps
  - **Self Aligned** process
  - Sacrificial oxide thickness defines gap sizes
- **All silicon** process
  - Polysilicon sense and drive electrodes
  - **CMOS compatible** materials and process steps



# Fabrication Process

 *Device Layer Silicon*  
 *Bottom Oxide*  
 *Handle Layer Silicon*  
 *Pad Oxide*

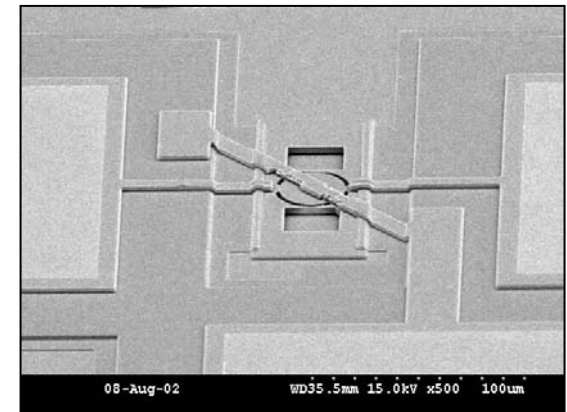
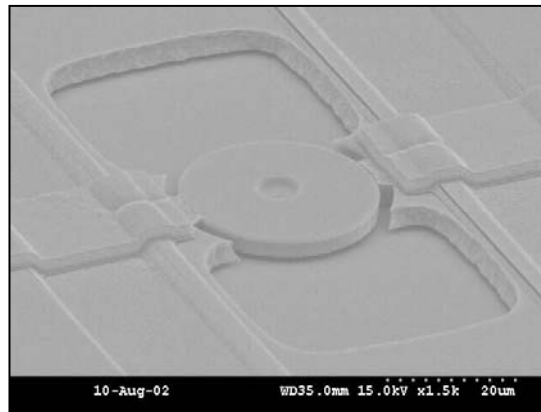
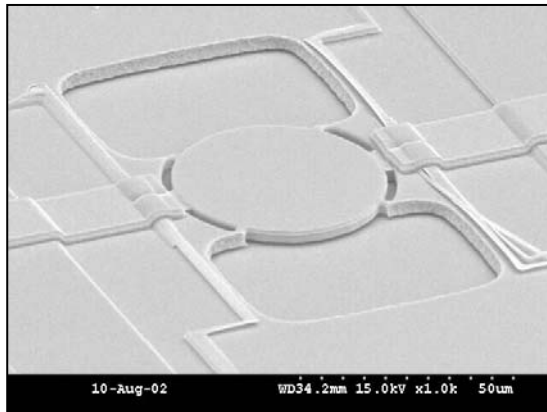
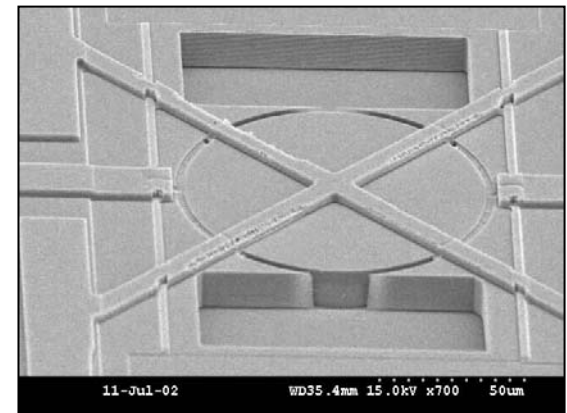
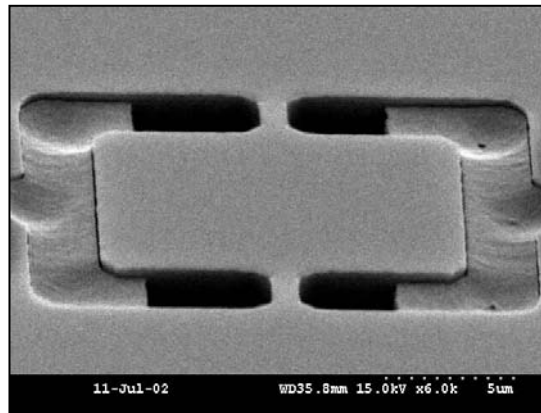
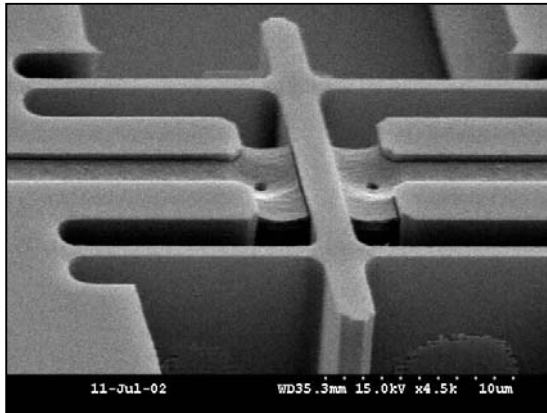
 *Nitride*  
 *Polysilicon*  
 *Sacrificial Oxide*  
 *Metal*



15 to 30 min HF dip

- sacrificial oxide in the resonator-electrode capacitive gaps is etched
- resonator structures are undercut and free to move

# Fabrication Results



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# Questions???