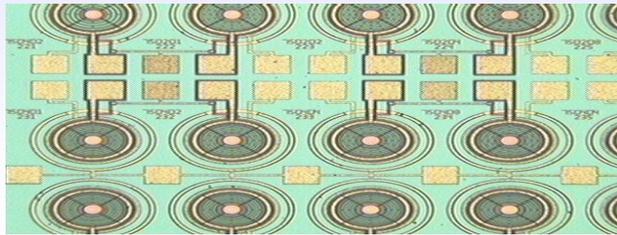


## Acoustic Sensors

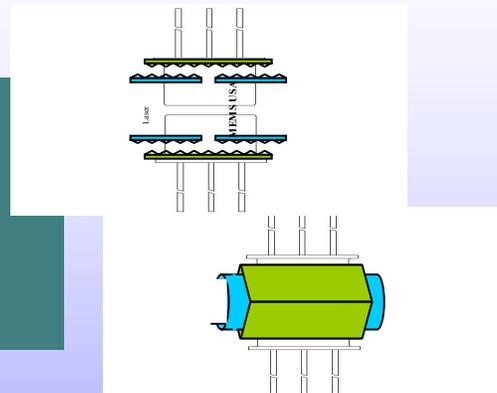


- Arrayed acoustic sensors for:
- Target determination/acquisition
  - MEMS microphones

## Packaging



Completed Accelerometer fits into 8 pin TO-5 Package

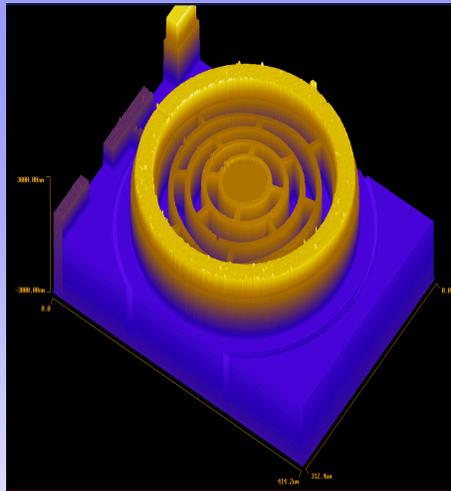
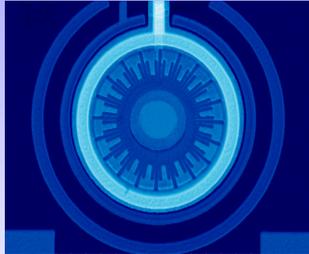


## Patents

- 6,581,465  
"Micro-electro-mechanical systems ultra-sensitive accelerometer"
- 6,550,330  
"Differential amplification for micro-electro-mechanical ultra-sensitive accelerometer"
- 6,546,798  
"Micro-electro-mechanical systems resonant optical gyroscope"

# MEMS

Micro-Electro-Mechanical Systems



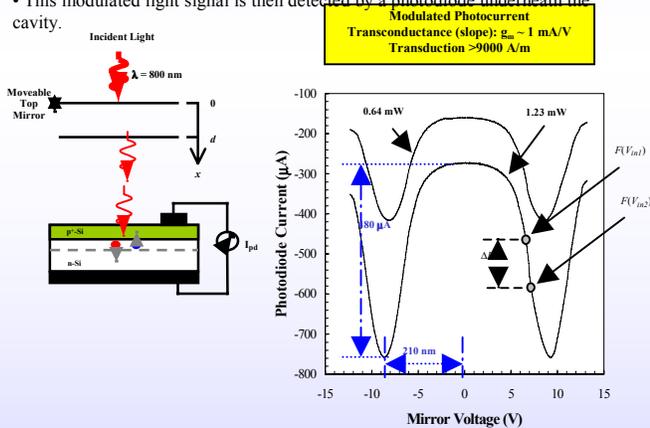
# USA

Ultra-Sensitive Accelerometer

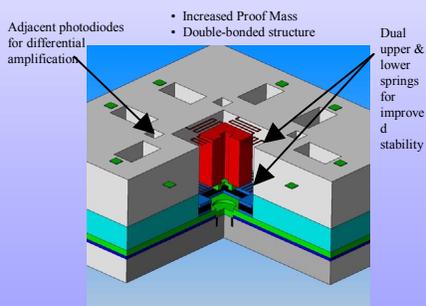


## Fabry-Perot Interferometer

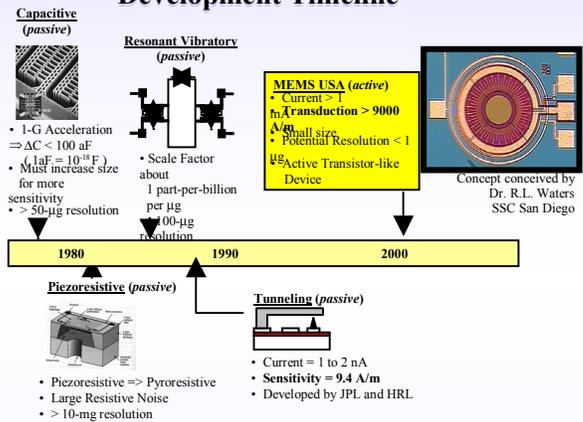
- The MEMS USA device is a tunable Fabry-Perot interferometer, composed of two parallel mirrors.
- The upper mirror is free to move with an applied force or acceleration, thereby adjusting the spacing between the mirrors.
- As the spacing changes, the transmission of light through the cavity is modulated.
- This modulated light signal is then detected by a photodiode underneath the cavity.



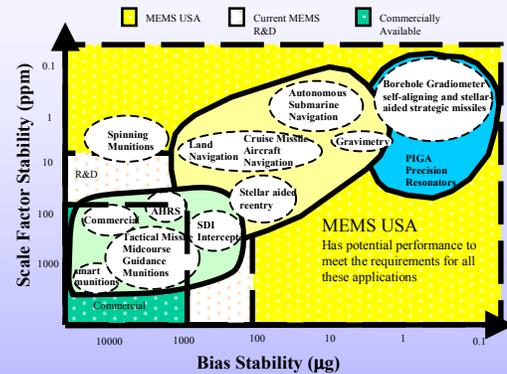
## Next-Generation MEMS USA Sensor



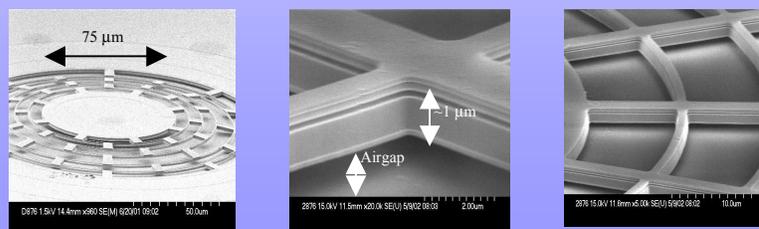
## MEMS Accelerometer Technology Development Timeline



## Accelerometer Performance Comparisons and Technology Chart



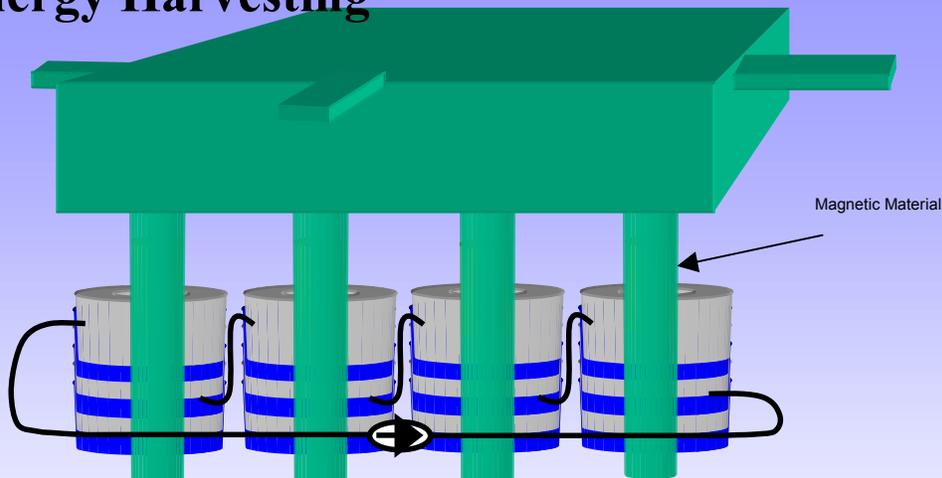
## SEM Micrographs of Released Sensor



# Energy Harvesting

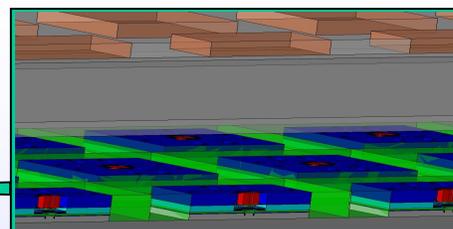
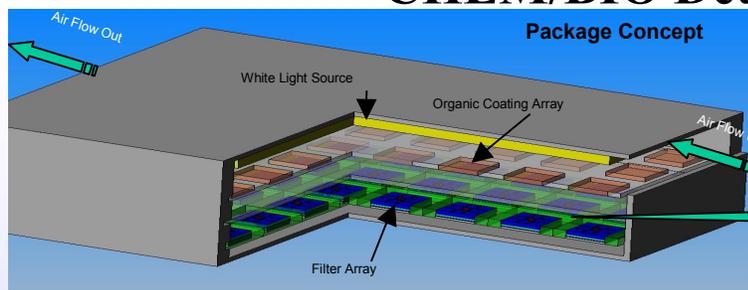
Mobile Phone Receiver uses  
~20fW

Theoretically expected power  
output ~10mW



Application	Frequency (Hz)	Excitation Amplitude ( $\mu\text{m}$ )
Car floor	10	400
Truck floor	10	800
Motorcycle handlebars	300	35

## CHEM/BIO Detection



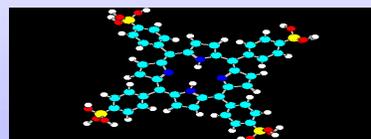
## Porphyrin Films

### Examples of Naturally Occurring Porphyrin Films:

Heme (Hemoglobin); Chlorophyll-a

### Chemicals / biological agents that can be detected with porphyrin films:

- Cyanide
- Proteins/toxins
- Nerve and Mustard Agent Simulants
- Amino and Nucleic acids
- Bacillus spores (Anthrax)
- Organics
  - ALCOHOLS
  - ACETONE/KETONES
  - FORMALDEHYDE
  - BENZENE
  - SUGARS



In the UV-visible absorption spectrum, the highly conjugated porphyrin macrocycle shows intense absorption (extinction coefficient  $> 200,000$ ) at around 400 nm (the "Soret" band), followed by several weaker absorptions (Q Bands) at higher wavelengths (450 to 700 nm). Variations of the peripheral substituents on the porphyrin ring often cause minor changes to the intensity and wavelength of these absorptions.