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# Microsystems Research

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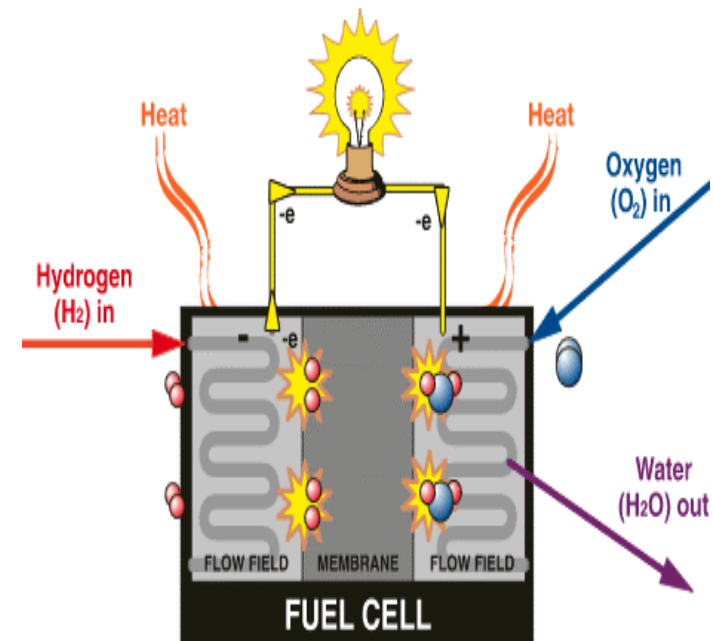
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*Department of Mechanical Engineering*



# Current Research Activities in MEMS/Transducer Lab

- ◆ **Proton Exchange Membrane (PEM) Fuel Cells:**
  - Hydrogen as fuel
  - Directly use methanol as fuel (DMFC)
- ◆ **Applications**
  - Mobile applications
  - Miniaturized fuel cell for portable electronics applications
- ◆ **Research issues**
  - The engineering fundamentals behind each functional component in the PEM fuel cells
  - Fuel cell design and fabrication
  - Fuel cell modeling
- ◆ **Goals:**
  - Optimal design and low cost fabrication
  - Performance improvement



# Current Research Activities in MEMS/Transducer Lab

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- ◆ Proton Exchange Membrane (PEM) Fuel Cells
- ◆ Research Projects:
  - **Micro PEM Fuel Cells for Portable Electronics**
    - » Supported by Pittsburgh Digital Greenhouse  
(09/01/2001-----)
  - **Other Supports: NSF, DOE**
- ◆ Research Collaborators
  - Faculty
    - Dr. Minking Chyu                      Dr. Qing-Ming Wang
    - Dr. Laura Shaefer                      Dr. Scott Mao
  - Students and Post-docs
    - Tao Zhang, etc.: Fuel cell design, fabrication ,test, modeling.
    - One post-doc is coming (12/01/01): Fuel cell fabrication & modeling

# Current Research Activities in MEMS/Transducer Lab

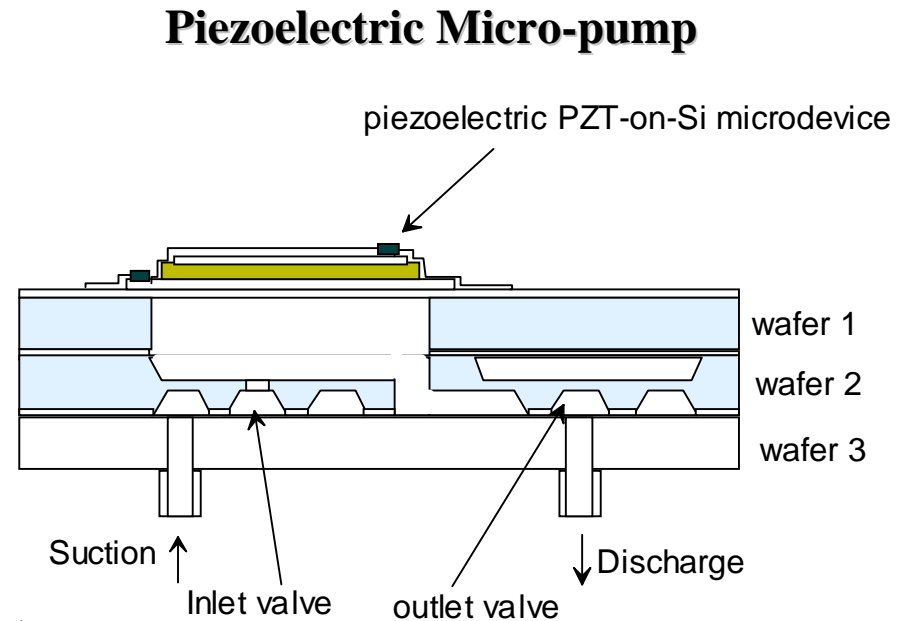


## ◆ Piezoelectric MEMS devices

- Processing research of thin/thick films of piezoelectric materials such as PZT
- Design and microfabrication of various piezoelectric MEMS devices

## ◆ Current Research Topics:

- Thick film PZT deposition
- PZT-on-Si microsensors and microactuators
  - » Micropumps
  - » Microvalves
  - » Force sensor arrays
  - » Piezoelectric power generation devices
  - » Microactuator array for high speed ink jet printing
- Micro-devices using electro-active polymers



# Current Research Activities in MEMS/Transducer Lab

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## ◆ Research activities on transducers also include:

- Piezoelectric actuators for fuel injection apparatus of direct gasoline-injection engines, and diesel engines
- Compact Piezoelectric Transformers
  - Both step-up & step down types
- Piezoelectric Micro-Actuators for hard disk drives(HDDs)
- Compact Piezoelectric Ultrasonic Motors

## ◆ Research issues:

- Design and fabrication of piezoelectric actuators
- Dynamic characterization of actuator devices
- Heat generation and reliability

# Current Research Activities in MEMS/Transducer Lab

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- ◆ **Piezoelectric MEMS and Transducers Research**
- ◆ **Projects:**
  - **Thin/Thick film PZT microdevices for MEMS applications**
    - » **University Internal Small Grants (07/01/01 ---06/30/03)**
  - **Other Supports:**
    - Pittsburgh Digital Greenhouse (PDG), NSF, DARPA, ONR**
- ◆ **Research Collaborators**
  - **Faculty**
    - Dr. William W. Clark**      **Dr. Jeffrey S. Vipperman**
  - **Students**
    - Qingming Chen, etc.**

# Current Research Activities in MEMS/Transducer Lab

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- ◆ **Piezoelectric MEMS and Transducers Research**

- ◆ **Investigators**

- **Faculty**

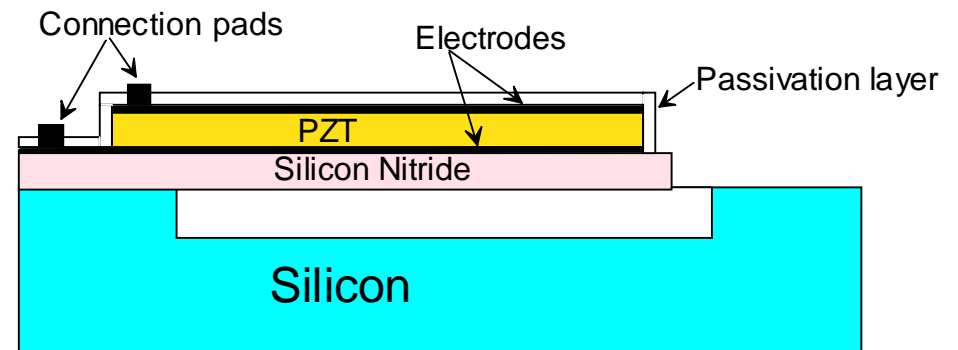
- Dr. Qing-Ming Wang**

- Dr. William W. Clark**

- Dr. Jeffrey S. Vipperman**

- **Students**

- Qingming Chen**



Piezoelectric PZT-on-Si  
cantilever resonator