SCME
Support Center for Microsystems Education

Education of *Engineering* Students to Support Medical Research and Treatment with BioMEMS

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Abstract - BioMEMS (Bio MicroElectroMechanicalSystems) is an emerging technology developed to support medical research, diagnosis and therapies within the medical community. BioMEMS are microscopic (1 mm to 200 um) sensors, transducers and actuators that can be used inside (vivo) or outside (vitro) the human body. An example of this type of device is a BioMEMS Continuous Glucose Monitoring with a Glucose Sensor and Micropump. Use of BioMEMS can lead to a better quality of life for patients. Understanding and designing the functioning of these types of devices by engineering and engineering technology students is essential in the support of medical technologies.

MEMS Glucose Monitor and Micropump

- The glucose is constantly monitored using an in vivo (implanted) chemical transducer (C).
- A micropump in (A) delivers insulin via a cannula (B) on an as-needed basis .
- D is the transmitter that relays the information from the glucose sensor (C) to the computer (A).

MiniMed Paradigm[R] REAL-Time System from Medtronic Diabetes [Printed with permission from Medtronic Diabetes]

Background

Ivy Tech Community College and Purdue University Polytechnic educate engineers to more in many areas to include: electrical circuits, electronics, mechatronic design and analysis and MEMS (Micro-Electo-Mechanical-Systems). These degrees rely on the use of science, technology, engineering and mathematics in support of the design, analysis and manufacturing of devices and systems for the support of our society. Our overall goal is to design and build what is needed for the greater good.

We train technicians and engineers to design, build and test, components, devices and systems that can be used to improve the quality of life for people around the world.

The technology used today is rapidly changing and the education we provide must keep pace with the demands for new products.

The challenge of education is to innovate and evolve but still teach the basic principles that govern how things work within budgetary restrictions.

Background (continue)

The use of BioMEMS is an application of MEMS devices that can be used for Applications for BioMEMS devices exist in clinical medicine, environmental, biological and chemical analysis. Applications from one area often overlap with other areas.

Applications can be broadly placed into the categories of

- clinical diagnostics and therapeutics,
- environmental applications including Homeland Security,
- food safety, and
- bioprocessing.

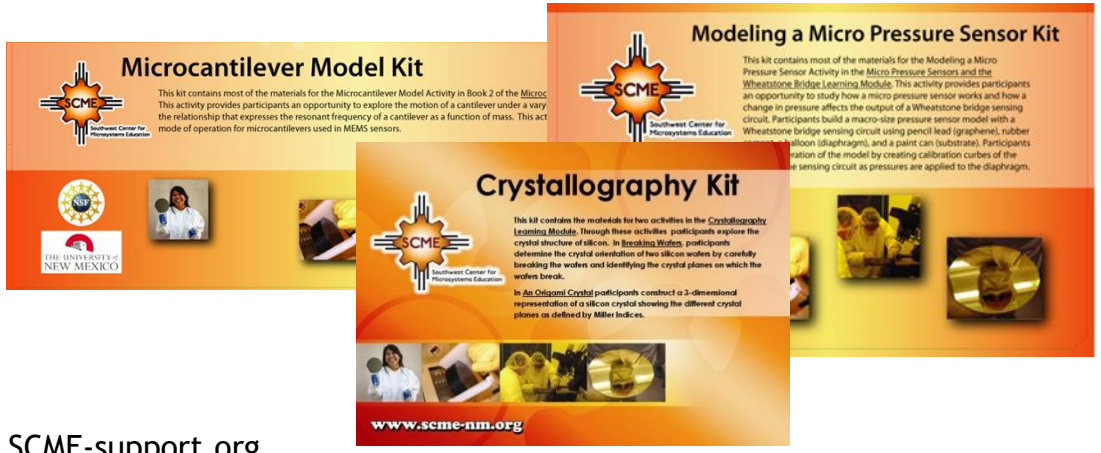
In addition, there are basic research applications that inform and drive applications in other areas.

BioMEMS sensor placement depends on the device and its application. A sensor can be

- topical (applied to skin or placed in the mouth)
- externally connected (*in vitro* or external with *in vivo* or internal device)
- implanted devices (totally *in vivo*)
- wireless

BioMEMS can use the same devices as other MEMS devices such as sensors, actuators and transducers.

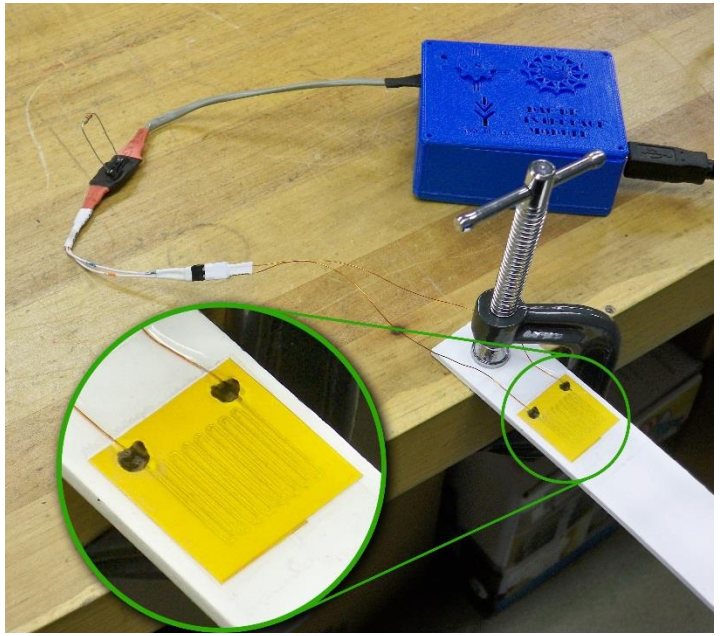
In 2014 we establish a working relationship with SCME from UNM for MEMS educations and we quickly adopted the use of three inexpensive kits. These kits could be used to teach students about MEMS devices.

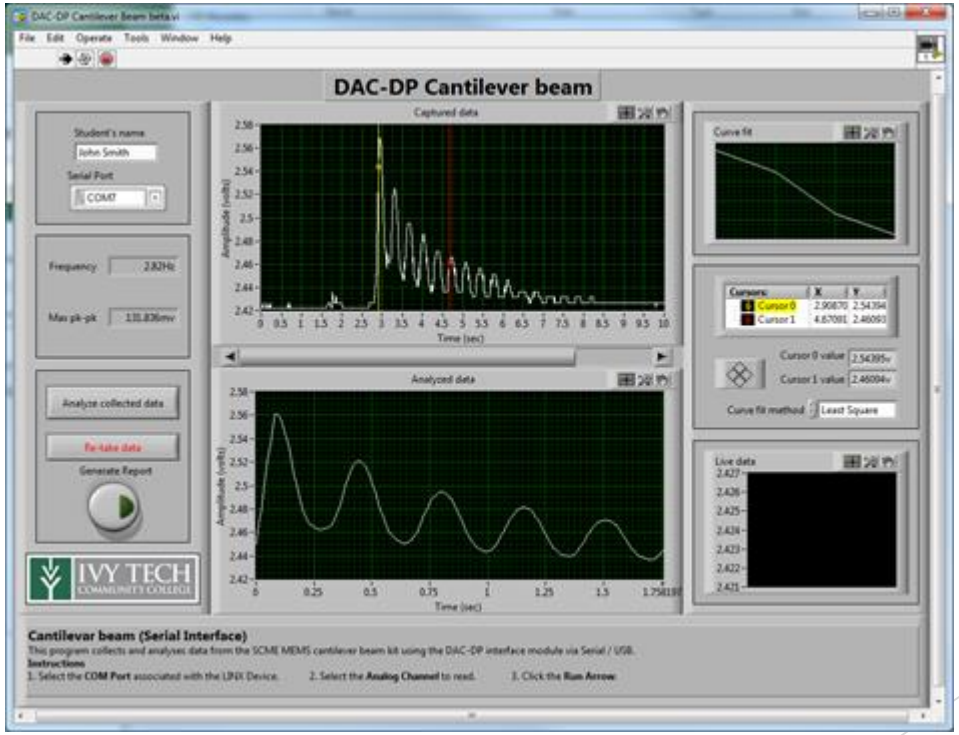


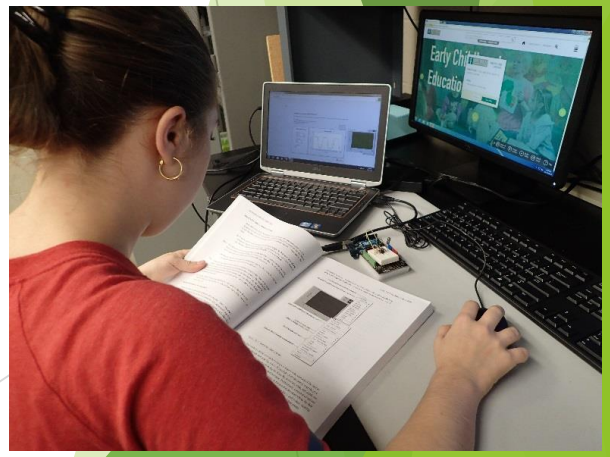
SCME-support.org

The new DAC-DP Kit for
SCME Cantilever Kit

Includes - Arduino Uno based DAC-DP interface module, instruction manual, executable LabView Data acquisition software, USB cable, and Cantilever beam Strain gauge interface – Discovered “How to make a Strain Gauge”

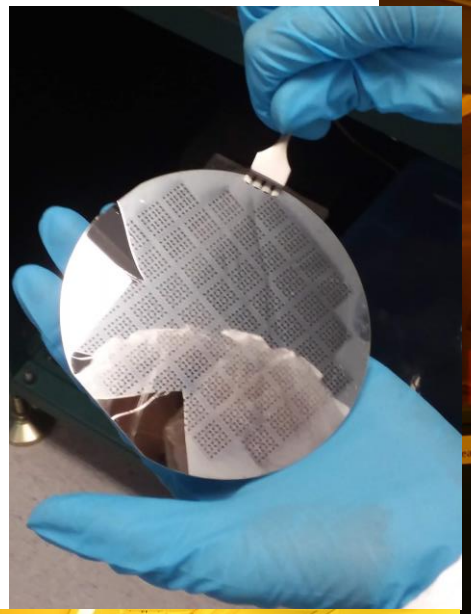






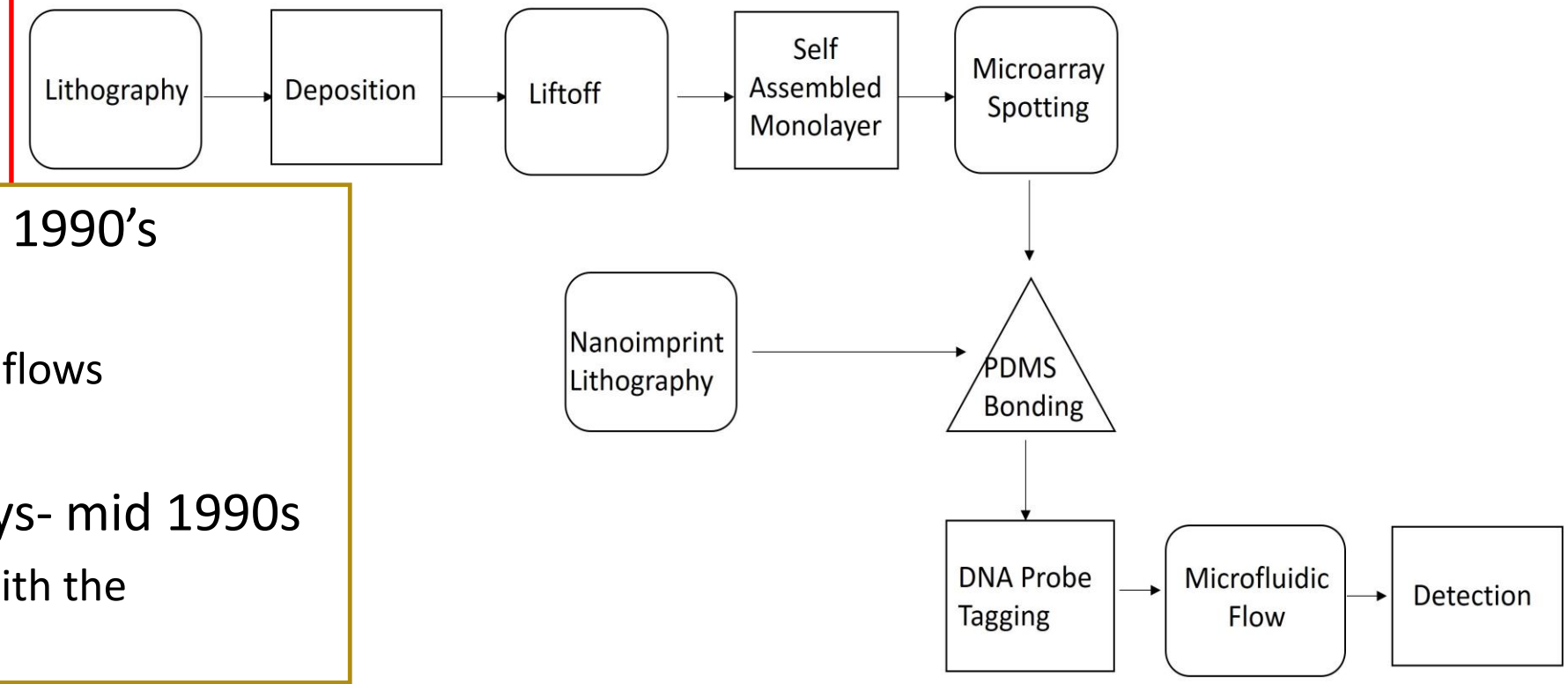
https://www.ivytech-mems.org/files/Using Arduino Uno and LabView to Learn MEMS Concepts.pptx

SCME-UNM Cleanroom with Ivy Tech students and faculty learning about pressure sensor fabrication in a cleanroom.

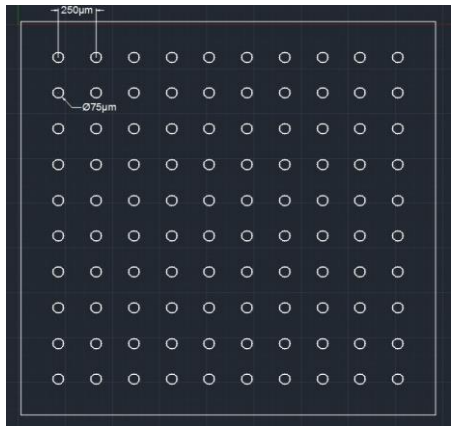


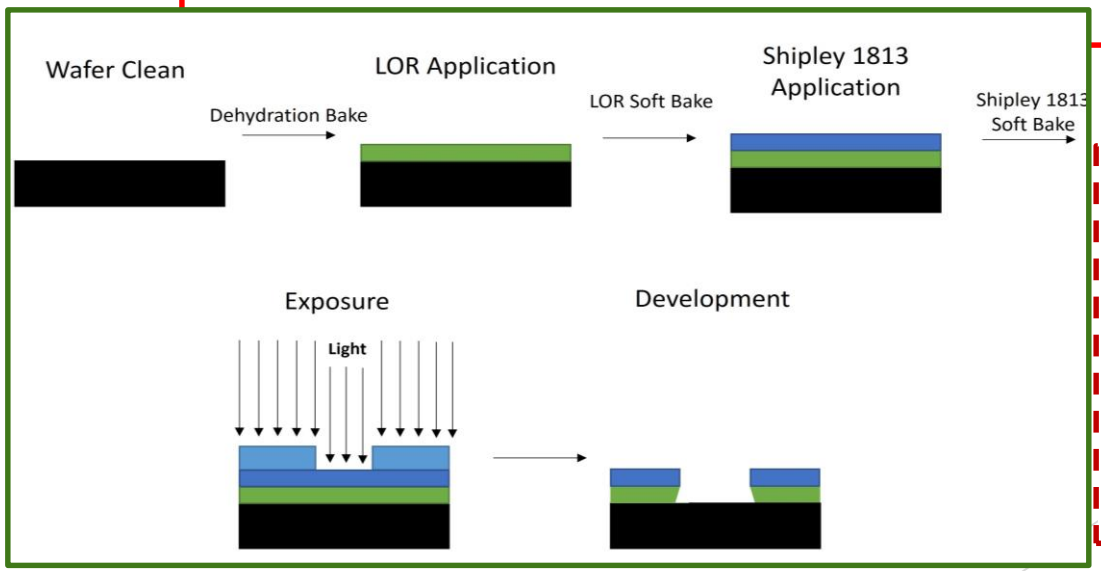
Microfluidics

- Pumping methods- mid 1990's
  - Electrokinetic
  - Surface tension driven flows
  - Acoustic streaming
- Coupled with Microarrays- mid 1990s
  - First commercialized with the Affymetrix GeneChip

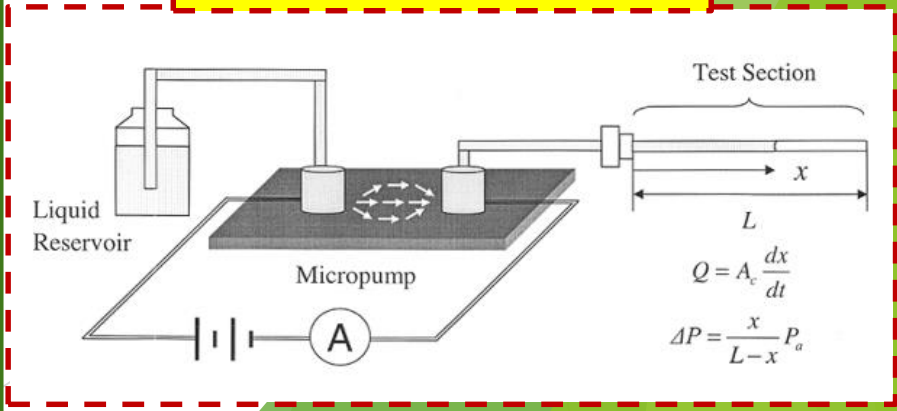


Mask for Lithography





Electro Osmotic Pumps



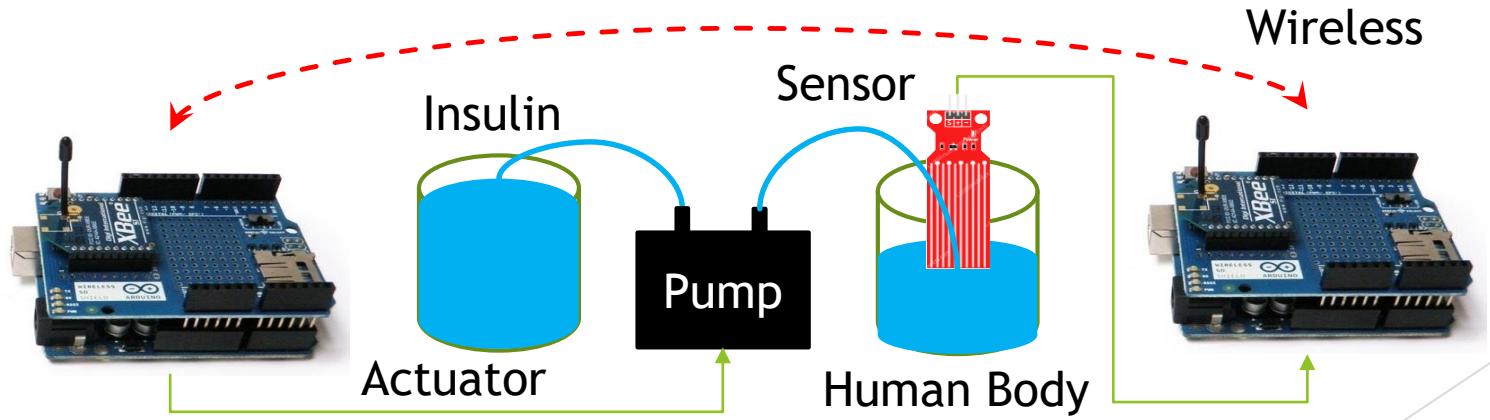
Collaboration between Ivy Tech, Purdue with support from SCME

Past

- Numerous presentations have been made at ATMAE, HI-TEC and MNT conferences
- Purdue and IvyTech both members of MNTeSIG group
- Ivy Tech SCME Modified kits have been shared with Purdue

Future

Purdue and Ivy Tech - Codevelop a BioMEMS Continuous Glucose Monitoring with a Glucose Sensor and Micropump kit than can be used for MEMS and BioMEMS education. Would probably be based on existing technology like Arduino UNO and shields with a tank and level sensor with a targeted cost per kit of $150 each.



Questions?

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