Semiconductor Devices Project Laboratory

How to design, fabricate, and characterize microdevices

Class of spring 2002

Instructors: Scott Manalis and Marty Schmidt

MEMS Project Lab Class

- Purpose: To gain experience in designing, simulating, fabricating, and testing a microfabricated device.
- Format: ~ 6 students work as a team on a single project.
- Project topic is aimed at advancing current research.

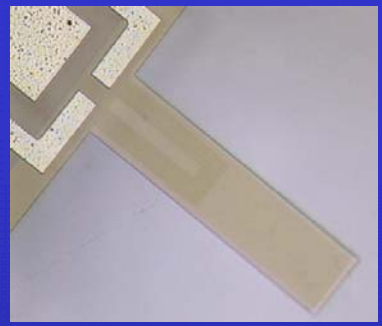
MTL - The Facilities

- Integrated Circuits Laboratory
  - Class 10 - 2800 sq.ft. (6")
  - 1.25 micron CMOS baseline process
- Technology Research Laboratory
  - Class 100 - 2200 sq.ft. (6")
  - Flexible Process Environment
- Exploratory Materials Laboratory
  - Class 1000 - 2000 sq.ft.
  - Thin Film Process Facility
- *IC Design Laboratory*
  - *Foundry IC Processes*

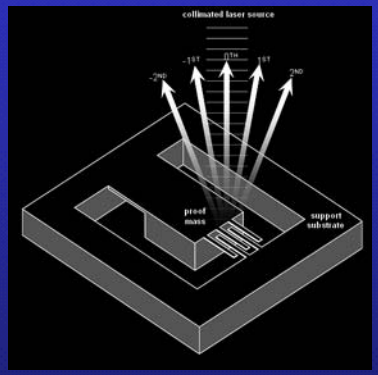
Organization

- Prerequisites: 6.152 or consent of instructors.
- Class officially meets 1-2 times per week for 1 hour.
- Time commitment is ~15 hrs/week.
- Smaller teams of 2-3 are often created for sub-projects.
- Dropping course mid-semester is not allowed.
- Grades are based on participation, final report, and project outcome.
- Concept of class project is often used for future research.

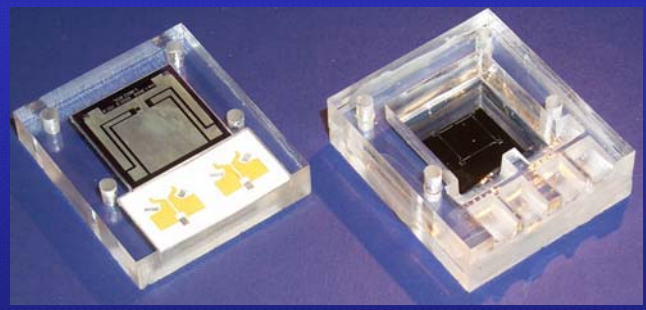
A History of MEMS Class Projects



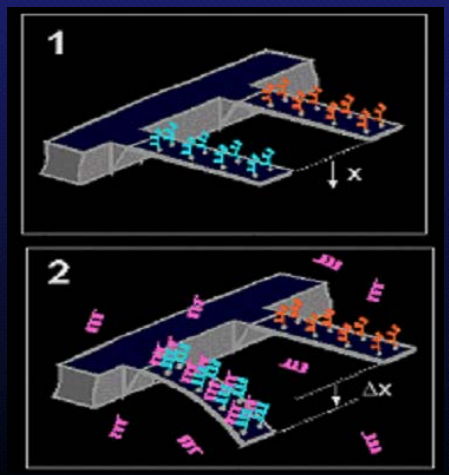
Spring 1999
Silicon Piezoresistive Cantilever



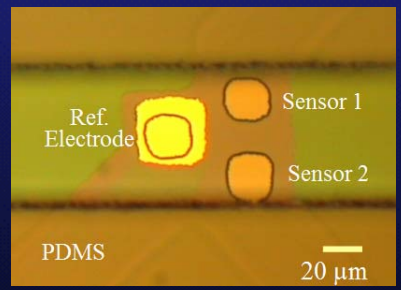
Fall 1999
Interferometric Accelerometer

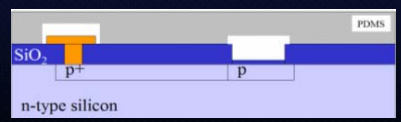


Spring 2000
Interferometric Accelerometer v2 with Custom Photodiodes



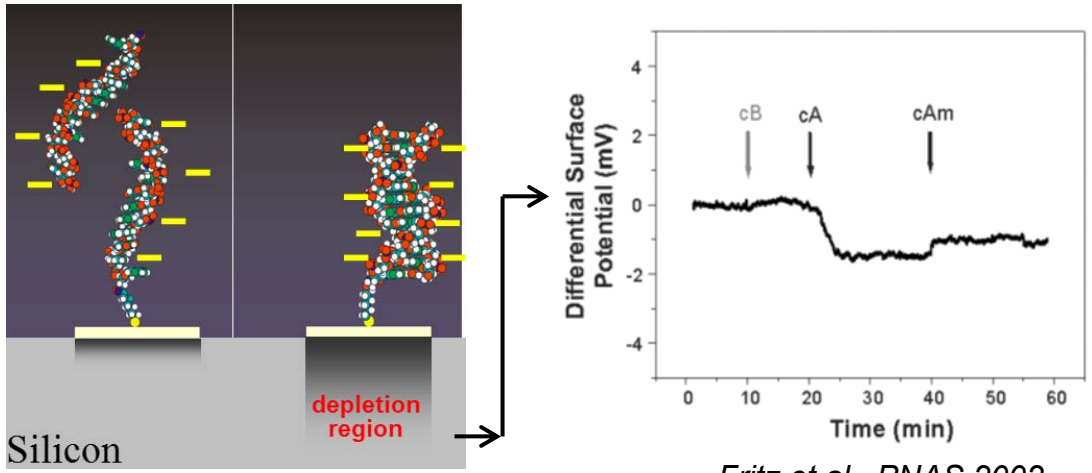
Spring 2001
Nanomechanical Biosensor with Interferometric Detection





Spring 2002
Silicon field-effect biosensor

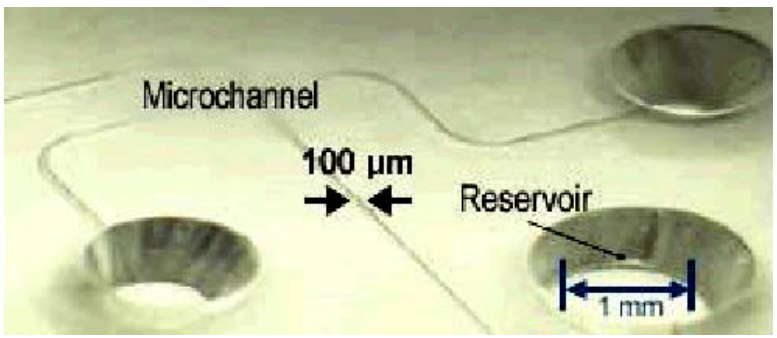
Electronic analysis of DNA by its intrinsic charge

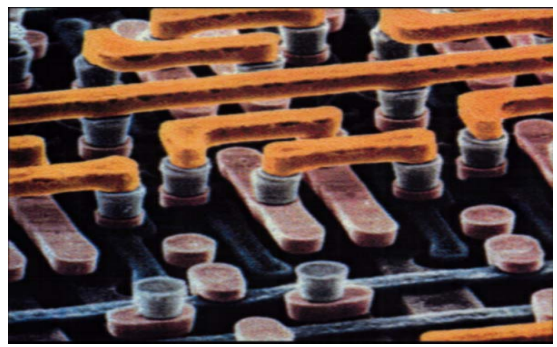


Fritz et al., PNAS 2002

Class of Spring 2002

Integrate microfluidics and microelectronics



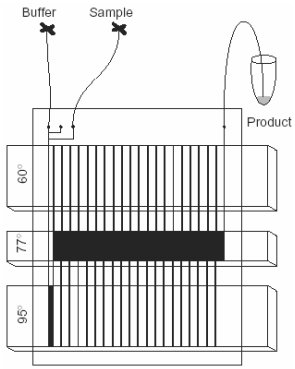


6.151 Microfabrication Project Laboratory, Fall 2003

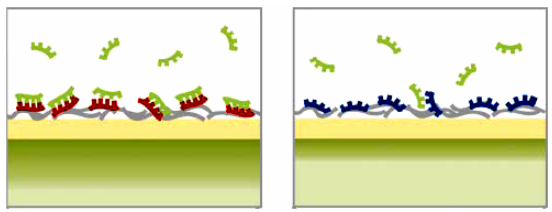
Integrating PCR amplification with silicon field-effect sensors for real-time DNA detection

Instructors:	Professors Scott Manalis and Marty Schmidt
Guest Instructor:	Dr. Raj Chakrabarti
Advisors:	Maxim Shusteff, Peter Russo and Dr. Paul Benning
Prerequisites:	6.152 or equivalent
Time:	TBD
First meeting:	September 3 at 1 pm in the Adler Room (39-327)

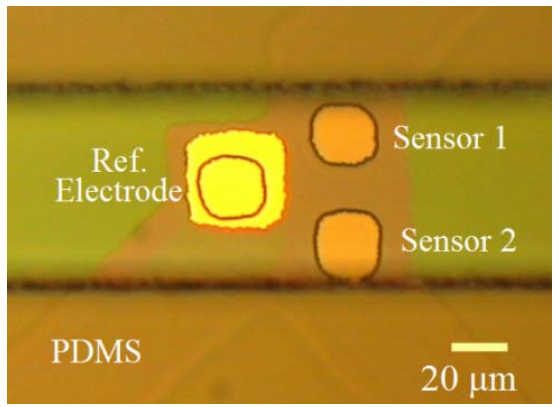
The project goal for fall 2003 is to integrate PCR, silicon field-effect sensors, and microfluidics for applications that require real-time and point-of-use DNA analysis. In achieving this goal, students will gain first-hand experience with MEMS design, process development, fabrication in the Microsystems Technology Laboratory and device characterization as well as biochemical methods relevant for performing PCR. This course will require ~12 hours per week. Please pre-register by emailing your academic/research background and course schedule for fall 2003 to: scottm@media.mit.edu.



1998: Kopp et al. micromachined a chemical amplifier to perform polymerase chain reaction (PCR) in continuous flow at high speed. (*Science* **280** 1046)



2002: Fritz et al. reported the selective and real-time detection of label-free DNA using a silicon field-effect detector. (*PNAS* **99** 14142)



2002: The 6.151 class successfully integrated PDMS microfluidics with planar silicon field-effect sensors.