

Microelectronics and VLSI @IITM

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Welcome to IIT Madras!

Microelectronics and VLSI group

- Microelectronics and MEMS
 - Device fabrication
 - Device modelling
- VLSI group
 - Analog/Mixed-signal/RF IC design
 - VLSI and FPGAs for DSP architectures
 - CAD

Microelectronics: Faculty members

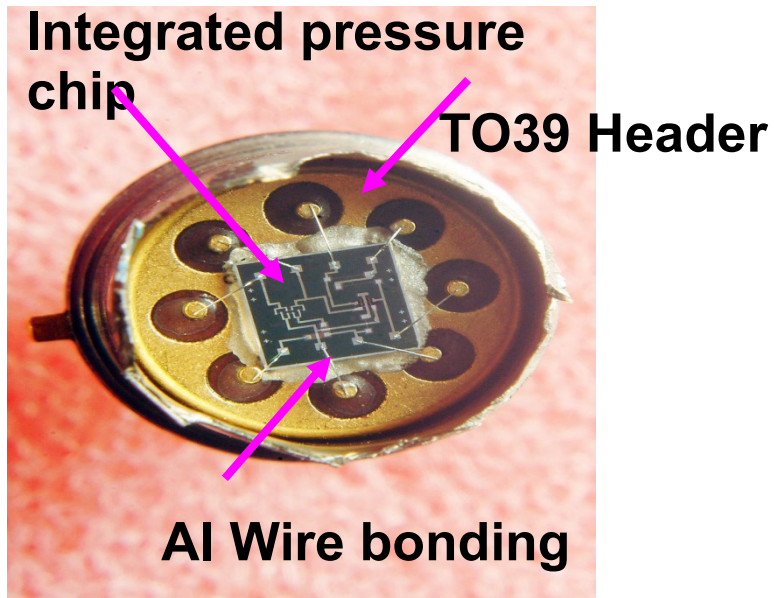
- Amitava DasGupta
 - Anjan Chakravorty
 - Enakshi Bhattacharya
 - Nandita DasGupta
 - Shreepad Karmalkar
- +Active collaboration with faculty from Physics, BioTech, ...

Microelectronics: Research areas

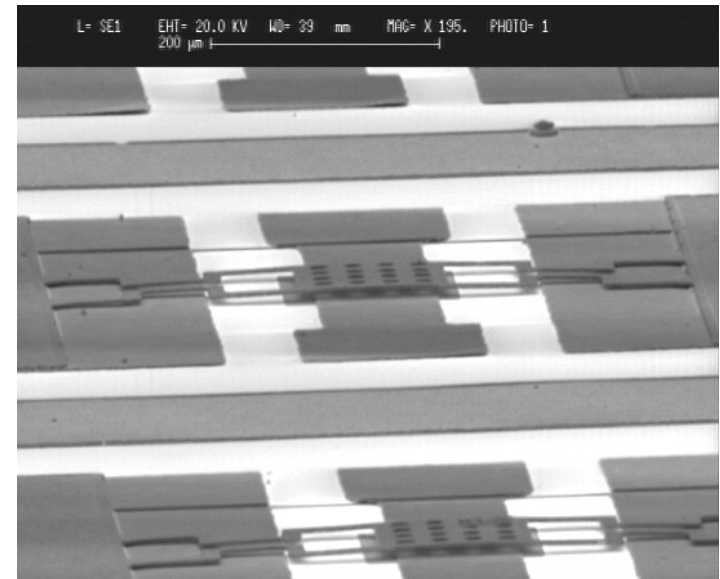
- Si, GaAs, and InP devices
- MEMS and Biosensors
- Device modelling and simulation
- Ultra thin oxide and high-K dielectrics for MOSFETs
- GaN LEDs
- Photonic devices
- Nanoelectronic devices

Microelectronics Research: Examples

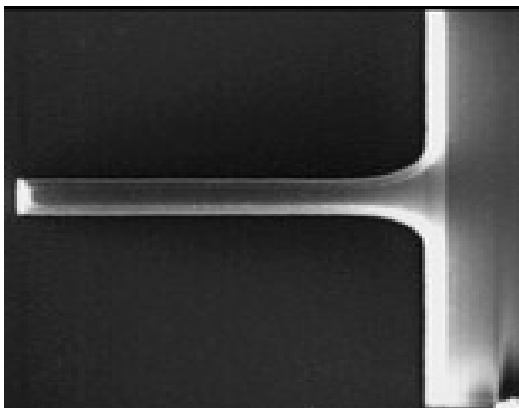
Pressure sensor



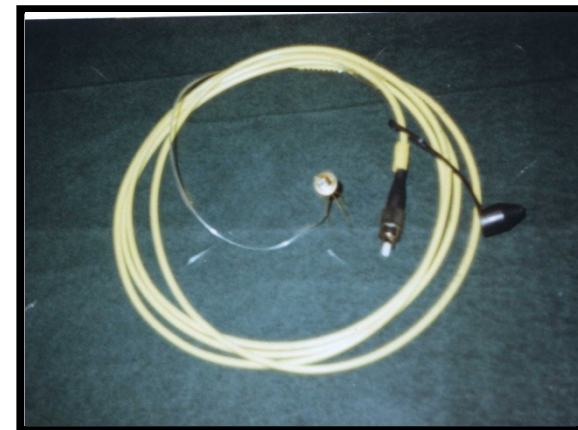
RF MEMS switch



Poly-Si cantilever



p-i-n photodetector



Microelectronics: Recent papers

- Prakash KAG, “Design and Fabrication of a Micro-mirror for Low Resolution Spectroscopy,” *IEEE Sensors Journal* 2010.
- Jayadeva GS, “Analytical Approximation for the Surface Potential in n-channel MOSFETs considering Quantum Mechanical Effects,” *IEEE Transactions on Electron Devices*, Aug. 2010.
- Jacob J, “Modeling Non-Quasi-Static Effects in SiGe HBTs,” *IEEE Transactions on Electron Devices*, Jul. 2010.
- Ajoy A, “On a simple scheme for computing the electronic energy levels of a finite system from those of the corresponding infinite system,” *J. Phys.: Condens. Matter*, Oct. 2010.
- Rathnamala Rao, “Study of Random Dopant Fluctuation effects in FD-SOI MOSFET using Analytical Threshold Voltage Model,” *IEEE Trans. On Device and Materials Reliability*, Jun. 2010.

[Only students' names shown above]

VLSI: Faculty members

- Aniruddhan S
- Nagendra Krishnapura
- Nitin Chandrachoodan
- Ravikumar CP (adjunct)
- Ravishankar A (adjunct)
- Shanthi Pavan
- Srinivasan S
- Vinita Vasudevan

VLSI: Research areas

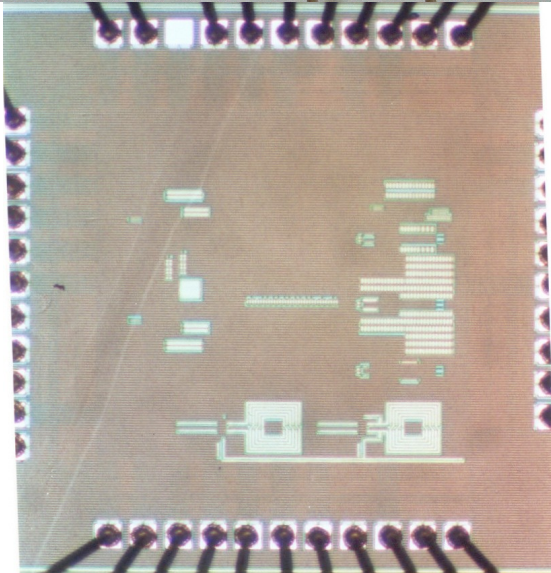
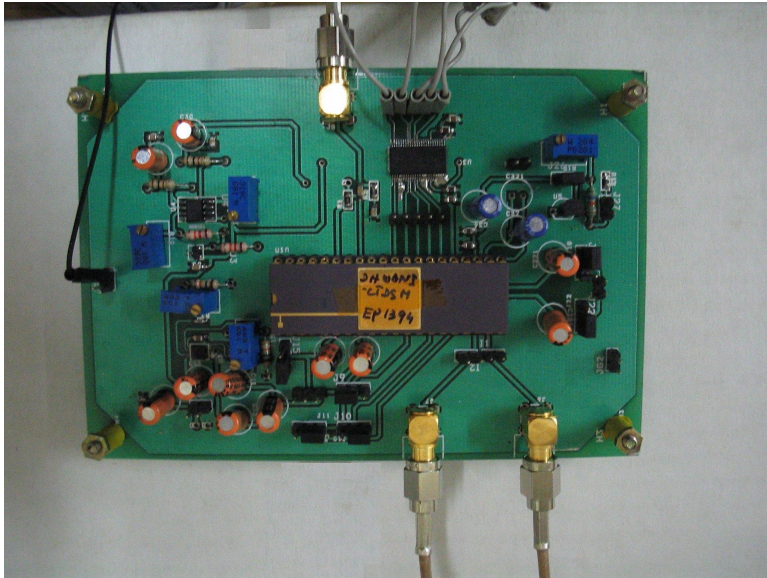
- Analog ICs
 - Delta-Sigma data converters
 - Continuous-time filters
 - Phase locked loops
- VLSI/FPGA architectures for DSP systems
- CAD
- Noise analysis

VLSI: Recent papers

- Jaiswal MK, “FPGA Based High Performance and Scalable Block LU Decomposition Architecture,” *IEEE Trans. Computers*, Feb. 2011.
- Singh V, “A 16MHz BW 75dB DR CT $\Delta\Sigma$ ADC compensated for more than one cycle excess loop delay,” *IEEE CICC*, Sep. 2011.
- Jain A, “A 4mW 1GS/S Continuous-Time $\Delta\Sigma$ Modulator with 15.6MHz Bandwidth and 67dB Dynamic Range,” *ESSCIRC*, Sep. 2011.
- Thambidurai C, “On Pulse Position Modulation and its Application to PLLs for Spur Reduction,” *IEEE Trans. Circuits and Systems I*, Jul. 2011.
- Singh V, “Compensating for Quantizer Delay in Excess of One Clock Cycle in Continuous-Time DS Modulators,” *IEEE Trans. Circuits and Systems II*, Sep. 2010.

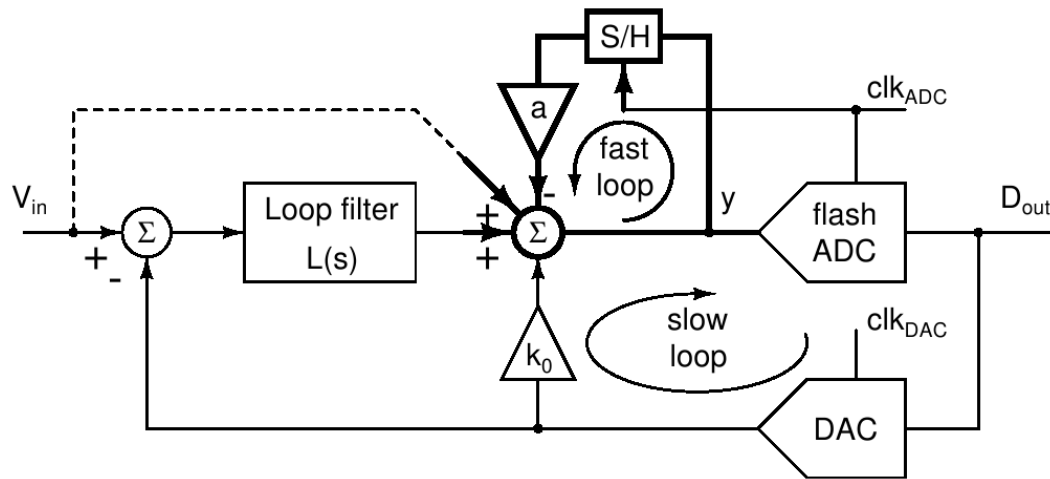
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VLSI: Examples

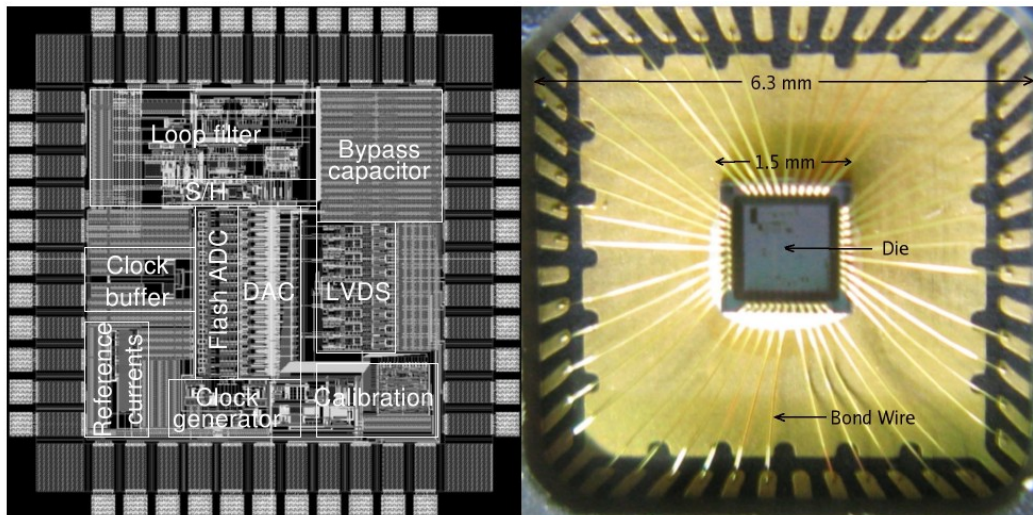


- Audio $\Delta\Sigma$ ADC
- 93dB dynamic range
- $90\mu\text{W}$
- 0.05pJ/level
- Lowest reported energy consumption per resolved level

VLSI: Examples



- 800MHz $\Delta\Sigma$ ADC
- 0.18 μm CMOS
- 75dB dynamic range
- Highest sampling rate reported in this process



Microelectronics+VLSI

- EISCAP Biosensor
 - MOS capacitance changes with pH
 - Readout circuitry to sense the changes
- RF MEMS switches

Facilities

- Microelectronics lab
 - Fabricate a variety of devices with down to $1\mu\text{m}$ feature size
- VLSI lab
 - Fabricate and test integrated circuit designs
 - Test DSP algorithms on FPGAs

Awards and Honors

- Technoshield award 2008, 2009-India semiconductor association
- Technomentor award for faculty, Technovation awards for students-India semiconductor association
- IEEE Darlington award
- Swarnajayanthi, INAE fellowships
- Young faculty recognition awards-IITM

Where do our students go from here?

- Faculty positions at NITK, IITG, NMAMIT, ...
- Core technical jobs in Texas Instruments, Cosmic Circuits, Aura Semiconductors, TSMC, IBM, ...
- PhD positions in various universities

For more information

- Microelectronics: <http://www.ee.iitm.ac.in/mems/>
- VLSI: <http://www.ee.iitm.ac.in/vlsi/>

Research versus courses

- Longer attention span, persistence
- Self driven

Information and Inspiration

- IEEEXplore: <http://www.ieeeexplore.org>
- How to read papers
 - <http://www.sigcomm.org/ccr/drupal/files/p83-keshavA.pdf>
- Richard Hamming: “You and Your Research”
 - <http://www.cs.virginia.edu/~robins/YouAndYourResearch.pdf>
 - <http://www.cs.utexas.edu/users/dahlin/bookshelf/hamming.htm>

Welcome to IIT Madras
and
all the best with your research!