FABRICATION TECHNIQUES FOR MEMS-BASED SENSORS : CLINICAL PERSPECTIVE

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INTENDED AUDIENCE : Engineering Students, Faculty from Engineering Colleges

PRE-REQUISITES : Basic Electronics

INDUSTRIES SUPPORT : Companies working in semiconductors and integrated circuits: Intel, AMD, Samsung, Texas Instruments, Analog Devices etc.

COURSE OUTLINE :

This course is designed with an aim of educating students in the area of microtechnology and its use to fabricate sensors and systems. The students will have an exposure to sensors and its importance in the real world. The students will also able to understand how to fabricate some of those sensors. Several examples of engineering devices used in clinical research will be also covered. Class 10000 non-conventional clean room and some equipment within it will also be shown. Below are some of the course outcomes. Ability to understand microfabrication process Understand sensors used in electronics and biomedical areas Understand Clean Room (Class 1 to Class 10000) Understand Microengineering Technology Design the process flow for fabricating microheater required in gas sensors. Design the process flow for fabricating forces sensors for biomedical application. Design microheater for gas sensors as per specifications. Design force sensors as per specifications. Understand fabrication of microfluidic platforms, micro-cantilevers, flexible force sensors, inter-digitated electrodes, polymer-glass bonding etc. for clinical research

ABOUT INSTRUCTOR :

Prof. Hardik J. Pandya is an assistant professor in the Department of Electronic Systems Engineering, Division of Electrical Sciences, IISc Bangalore where he is developing Advanced Microsystems and Biomedical Devices Facility for Clinical Research and Biomedical and Electronic (10-6-10-9) Engineering Systems Laboratory to carry out cutting-edge research on novel devices to solve unmet problems in biology and medicine. He is recipient of prestigious Early Career Research Award from Science and Engineering Research Board, Government of India as well as a start-up grant of 228 Lacs from IISc. He has taught Design for Analog Circuits, Analog Integrated Circuits, VLSI technology, and Semiconductor Devices to undergraduate and graduate students from Electronic Engineering, Instrumentation Engineering, and Applied Physics. He seek to understand and exploit novel ways of fabricating microengineering devices using glass, silicon, polymers and integrate with unusual classes of micro/nanomaterials. His research interests include integrating biology/medicine with micro- and nanotechnology to develop innovative tools to solve unmet clinical problems. His current research focuses on flexible sensors for smart catheters, microsensors, microfluidic devices, and microelectromechanical systems, all lately with an emphasis on cancer diagnosis, therapeutics, e-nose, and biomedical device technologies. Before joining IISc, he worked as a postdoctoral scientist in the Department of Mechanical Engineering, Maryland Robotics Center, University of Maryland, College Park and in the Department of Medicine, Brigham and Women's Hospital–Harvard Medical School affiliated with Harvard-MIT Health Science and Technology. His work has resulted in several patents and publications. His work has been highlighted as "Breaking Research News" by The Physicians Committee for Responsible Medicine and has been featured on IEEE Transactions on Biomedical Engineering July 2016 issue cover image as well as IEEE TBME July 2016 feature article for the website and monthly highlights. The work on portable cancer diagnosis tool was also featured on Science Translational Medicine as an Editorial Choice, Breast Cancer Diagnosis, March 2016 and has been highlighted on CapeRay blog as "Biochips and Diagnostic tools" in April 2016. His work has been published in high-quality journals including Lab on a Chip, IEEE Transactions on Biomedical Engineering, IEEE Journal of Microelectromechanical Systems, Sensors and Actuators B, Biosensors and Bioelectronics, Nanoscience and Nanotechnology Letters, Sensors and Transducers, and Journal of Micromechanics and Micromachining.

COURSE PLAN :

Week 01 : Introduction to microengineering devices and its applications

Week 02 : Clean room, contaminants, wafer cleaning processes (DI water, RCA, metallic impurities, etc.).

Week 03 : Introduction to the microheater, force sensors, microfluidic devices, its specifications, and applications.

Week 04 : Masks: Types of masks, Types of Photoresists, Spin Coaters Lithography process: optical lithography, x-ray, and e-beam lithography, lift-off techniques, soft lithography, Use of resists (spin coating, positive and negative photoresists), photoresist pre-baking, exposure, and development.

Week 05 : Etching: Isotropic/anisotropic, selectivity, wet and plasma assisted etching.

Week 06 : Types of wafers and orientations. Techniques of metallization: PVD [(Sputtering – DC, RF and Magnetron), thermal evaporation, e-beam evaporation].

Week 07 : Chemical Vapor Deposition: Dielectric films (Plasma Enhance Chemical Vapor Deposition (PECVD)), Atomic Layer Deposition

Week 08 : Understanding and designing the process flow for fabricating microengineering devices. Process flow for microheater, force sensors, and microfluidic devices.

Week 09 : Wafer dicing and bonding techniques. Microfluidic Chips

Week 10 : Process Flow for Fabricating Flexible Force Sensors and Force Sensors on Silicon, Process Flow for Fabricating VOC sensors, Biochips

Week 11 : Clinical Research: Problems and Solutions using Microengineering Device

Week 12 : Visit to non-conventional Class 10000 Clean Room and discussing few equipment within.