

# EE607: MICROELECTROMECHANICAL SYSTEMS (MEMS)

Technology methods and physical principles of MEMS including survey of current MEMS

- Instructor: Prof. Eun Sok Kim (eskim@usc.edu, PHE 602, 740-4697)
  - Office Hours: Wednesday and Friday 3:00-3:50
- Class Time and Place: Friday 9:00 – 11:50am
- Textbook: My lecture notes from <http://blackboard.usc.edu/>

The following books may be helpful on some specific topics of the course.

- Micromachined Transducers Sourcebook by Gregory Kovacs
- Fundamentals of Microfabrication by Marc Madou
- Introduction to Microelectromechanical Systems Engineering by Nadim Maluf
- Microsystem Design by Stephen Senturia
- RF MEMS Theory, Design and Technology by Gabriel Rebeiz
- Microsensors, MEMS and Smart Devices by Julian Gardner, et al.
- Foundations of MEMS by Chang Liu

# Solid State Sensor Actuator Workshop

**IEEE Electron Devices Society**



## **Solid State Sensor Actuator Workshop:**

**Solid-State Sensor and Actuator Workshop, 1988. Technical Digest., IEEE. ,1988**      **Solid-State Sensor and Actuator Workshop, 1990. 4th Technical Digest., IEEE. ,1990**      *Solid-state Sensor and Actuator Workshop ,1996*  
*Solid-State Sensor and Actuator Workshop, Hilton Head Island, South Carolina, June 3-6, 1996 ,1996*      **IEEE**  
**Solid-State Sensor and Actuator Workshop** IEEE Electron Devices Society,1988      **IEEE Solid-State Sensor and Actuator Workshop ,1992-01-01**      **3rd Ieee Solid State Sensor and Actuator Workshop ,1988**      **MEMS Vibratory Gyroscopes** Cenk Acar,Andrei Shkel,2008-12-16 MEMS Vibratory Gyroscopes provides a solid foundation in the theory and fundamental operational principles of micromachined vibratory rate gyroscopes and introduces structural designs that provide inherent robustness against structural and environmental variations In the first part the dynamics of the vibratory gyroscope sensing element is developed common micro fabrication processes and methods commonly used in inertial sensor production are summarized design of mechanical structures for both linear and torsional gyroscopes are presented and electrical actuation and detection methods are discussed along with details on experimental characterization of MEMS gyroscopes In the second part design concepts that improve robustness of the micromachined sensing element are introduced supported by constructive computational examples and experimental results illustrating the material      Solid State Sensor and Actuator IEEE Electron Devices Society,1990      **IEEE Solid-State Sensor and Actuator Workshop** Institute of Electrical and Electronics Engineers (New York, N.Y.),1988      *Solid-State Sensor and Actuator Workshop, Hilton Head Island, South Carolina, June 2-6, 2002 ,2002*      *Solid-state Sensor and Actuator Workshop ,1996*      **Solid-State Sensor and Actuator Workshop, Hilton Head Island, South Carolina, June 13-16, 1994 ,1994**      **Solid-State Sensor and Actuator Workshop, Hilton Head Island, South Carolina, June 4-8, 2000** Transducers Research Foundation, Inc,2000      **Sensors, Mechanical Sensors** Wolfgang Göpel,Joachim Hesse,J. N. Zemel,2008-11-20 Sensors is the first self contained series to deal with the whole area of sensors It describes general aspects technical and physical fundamentals construction function applications and developments of the various types of sensors This volume contains the physical and technical fundamentals of mechanical sensors and contains and assesses the various types of sensors for particular applications Of interest to engineers physicists chemists and others involved in sensor technology      *From MEMS to Bio-MEMS and Bio-NEMS* Marc J. Madou,2011-06-13 From MEMS to Bio MEMS and Bio NEMS Manufacturing Techniques and Applications details manufacturing techniques applicable to bionanotechnology After reviewing MEMS techniques materials and modeling the author covers nanofabrication genetically engineered proteins artificial cells nanochemistry and self assembly He also discusses scaling laws in MEMS and NEMS actuators fluidics and power and brains in miniature devices He concludes with coverage of various MEMS and NEMS applications Fully illustrated in color the text contains end of chapter problems worked examples extensive references for further reading and an extensive glossary of terms Details the

Nanotechnology Biology and Manufacturing Techniques Applicable to Bionanotechnology Topics include Nonlithography manufacturing techniques with lithography based methods Nature as an engineering guide and contrasts top down and bottom up approaches Packaging assembly and self assembly from ICs to DNA and biological cells Selected new MEMS and NEMS processes and materials metrology techniques and modeling Scaling laws actuators power generation and the implementation of brains in miniaturizes devices Different strategies for making micromachines smarter The transition out of the laboratory and into the marketplace The third volume in Fundamentals of Microfabrication and Nanotechnology Third Edition Three Volume Set the book discusses top down and bottom up manufacturing methods and explains how to use nature as a guide It provides a better understanding of how to match different manufacturing options with a given application that students can use to identify additional killer MEMS and NEMS applications Other volumes in the set include Solid State Physics Fluidics and Analytical Techniques in Micro and Nanotechnology Manufacturing Techniques for Microfabrication and Nanotechnology

**Micromixers** Nam-Trung Nguyen, 2008-05-07 A wide range of applications in chemistry and biochemistry are driving the rapid development of microfluidics This book focuses its attention on an important subtopic of microfluidics mixing in microscale It provides the fundamentals of transport effects in microscale including molecular diffusion convection and chaotic advection The science and technology of microfluidics cover a wide spectrum and the science of mixing in microscale has evolved from reports on fabricated devices to an extensive collection of established knowledge The focal point of Micromixers Fundamentals Design and Fabrication is the current applicable knowledge and practical issues in designing fabricating and characterizing micromixers in the chemical and biochemical industries Based on scaling law it recommends practical micromixer designs utilizing the advantages of the microscale effects The book is intended for practicing engineers and for upper level undergraduate and graduate level students Provides the basic terminology and fundamental physics of transport effects used for designing micromixers Highlights the challenges and advantages of miniaturization in mixing Outlines currently available microtechnologies for fabricating micromixers Discusses current applications including lab on a chip for chemical biochemical analysis and chemical production Defines concepts such as electrohydrodynamic dielectrophoretic electrokinetic magneto hydrodynamic acoustic and thermal effects and their implementation in micromixers

**Manufacturing Techniques for Microfabrication and Nanotechnology** Marc J. Madou, 2011-06-13 Designed for science and engineering students this text focuses on emerging trends in processes for fabricating MEMS and NEMS devices The book reviews different forms of lithography subtractive material removal processes and additive technologies Both top down and bottom up fabrication processes are exhaustively covered and the merits of the different approaches are compared Students can use this color volume as a guide to help establish the appropriate fabrication technique for any type of micro or nano machine

**The MEMS Handbook** Mohamed Gad-el-Hak, 2001-09-27 The revolution is well underway Our understanding and utilization of microelectromechanical

systems MEMS are growing at an explosive rate with a worldwide market approaching billions of dollars In time microdevices will fill the niches of our lives as pervasively as electronics do right now But if these miniature devices are to fulfill their mammoth potential today s engineers need a thorough grounding in the underlying physics modeling techniques fabrication methods and materials of MEMS The MEMS Handbook delivers all of this and more Its team of authors unsurpassed in their experience and standing in the scientific community explore various aspects of MEMS their design fabrication and applications as well as the physical modeling of their operations Designed for maximum readability without compromising rigor it provides a current and essential overview of this fledgling discipline

### **MEMS and MOEMS**

**Technology and Applications** P. Rai-Choudhury, 2000 The silicon age that led the computer revolution has significantly changed the world The next 30 years will see the incorporation of new types of functionality onto the chip structures that will enable the chip to reason to sense to act and to communicate Micromachining technologies offer a wide range of possibilities for active and passive devices Recent developments have produced sensors actuators and optical systems Many of these technologies are based on surface micromachining which has evolved from silicon integrated circuit technology This book is written by experts in the field It contains useful details in design and processing and can be utilized as a reference book or as a textbook

## Unveiling the Magic of Words: A Report on "**Solid State Sensor Actuator Workshop**"

In some sort of defined by information and interconnectivity, the enchanting power of words has acquired unparalleled significance. Their power to kindle emotions, provoke contemplation, and ignite transformative change is really awe-inspiring. Enter the realm of "**Solid State Sensor Actuator Workshop**," a mesmerizing literary masterpiece penned by way of a distinguished author, guiding readers on a profound journey to unravel the secrets and potential hidden within every word. In this critique, we shall delve to the book is central themes, examine its distinctive writing style, and assess its profound affect the souls of its readers.

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