ME 645

MEMS - Design, Fabrication, and Characterization

MEMS: Fabrication:

Conventional MEMS fabrication using VLSI technology: lithography, chemical etching: isotropic and anisotropic, Plasma etching, reactive ion etching (RIE), oxidation, chemical vapour deposition (CVD), LPCVD, PECVD, surface micromachining, LIGA, single layer and higher layer fabrication. Non-conventional MEMS fabrication: laser micromachining and welding, processing of metals and nonmetals with laser, Electro Discharge and Electro Chemical micromachining (EDM and ECM), Microstereolithography: scanning process, dynamic mask process. Electronic packaging.

MEMS: Design and Analysis:

Basic concepts of design of MEMS devices and processes, Design for fabrication, Other design considerations, Analysis of MEMS devices, FEM and Multiphysics analysis, Modeling and simulation, connection between molecular and continuum mechanics, MEM system level analysis from perspective of control theory.

MEMS: Characterization:

Technologies for MEMS characterization, Scanning Probe Microscopy (SPM): Atomic Force Microscopy (AFM), Scanning tunneling microscopy (STM), Magnetic Force Microscopy, Scanning Electron Microscope, Laser Doppler vibrometer, Electronic Speckle Interference Pattern technology (ESPI).

Examples and case studies: Comb actuator for nanopositioning stage by POLYMUMPS process

Text Books -

1. *Nadim Maluf, "An Introduction to Microelectromechanical Systems Engineering," Artech House, Boston, 2000.*
2. *Stephen D. Senturia, "Microsystems Design," Kluwer Academic Publishers, New York, November 2000*
3. *S. M. Sze, "VLSI Technology," McGraw-Hill International Editions, Singapore, 1988.*
4. *M.Elwenspoek and H. Jansen, "Silicon Micromachining," Cambridge University Press, Cambridge, UK, 1998.*
5. *Norio Taniguchi, editor "Nanotechnology," Oxford University Press, Oxford, UK, 2003.*
6. *Joseph McGeough, editor "Micromachining of Engineering Materials," Marcel Dekker, Inc., New York, 2002.*
7. Marc Madou, "Fundamentals of Microfabrication: The science of miniaturization," CRC Press, LLC, 2002.