

عنوان درس:

تئوری و فناوری ساخت افزاره های نیم‌رسانا

Theory and Manufacturing Technology of Semiconductor Devices

Module Subjects:

Weeks_1-2: Overview of Microelectronic Fabrication Techniques

Introduction, Basic processes in device fabrication, Basic MOS processes, Basic CMOS processes, Basic bipolar transistor processes, and Safety considerations

Weeks_3-5: Lithography

Overview of photolithography, Clean room, Wafer cleaning processes, Barrier layers, Positive and negative photoresists, Photoresist soft backing, Photomask, Mask alignment, and alignment marks, Photoresist exposure, Printing techniques, Resolution power, Depth of focus, UV light sources, Resolution enhancing techniques: optical proximity correction, phase shift mask, immersion lithography, and anti-reflection coating, Advanced lithography techniques: electron beam lithography, x-ray lithography, ion beam lithography, and extreme ultra violet lithography

Weeks_6-7: Etching

Wet etching, Silicon etching, GaAs etching, Silicon dioxide etching, Silicon nitride etching, Metal etching, Orientation dependent etching of silicon and GaAs, Dry etching, Plasma fundamentals, Simple capacitively coupled plasma etcher, Reactive ion etcher, Magnetically enhanced reactive ion etcher, Triode reactor ion etcher, Barrel plasma etcher, Inductively coupled plasma etcher, Electron cyclotron resonance plasma etcher

Week_8: Mid-term Exam

Weeks_9-10: Diffusion

Diffusion processes, Diffusion systems: open furnace-tube systems with solid, liquid, and gas sources, Diffusion equation, Constant source diffusion, Limited source diffusion, Concentration dependent diffusion, Multi-step diffusion, PN junction formation, Sheet resistance, Ervine's curves, Four point probe, Van der Pauw's method, Measuring junction depth: groove and stain method, impurity profile measurement using SIMS

Week_11: Ion Implantation

Basic parts of a ion implantation system, Mathematical model for ion implantation, Selective implantation, Junction depth, Ion channelling, Lattice damage and annealing, Shallow implantation, Rapid thermal annealing, Transient enhanced diffusion

Weeks_12-13: Film Deposition Techniques

Film deposition by evaporation: filament evaporation, electron beam evaporation, flash evaporation, kinetic gas theory, shadowing and step coverage, Sputtering, Chemical vapour deposition (CVD), CVD reactors, Deposition of silicon dioxide, silicon nitride, polysilicon, and metals by CVD technique

Weeks_14-15: Interconnections and Contacts

Interconnections in integrated circuits, Ohmic contact formation, Aluminum-silicon eutectic behaviour, Contact resistance, Electromigration, Diffused interconnections, Buried contacts, Butted contacts, Silicides, Polycides, Salicides, Barrier metals and multilayer contacts, Basic multilevel contacts, Planarized metalization, Low dielectric constant interlevel dielectrics, Electroplated copper intercontacts, Damascene plating, Dual Damascene structures

Week_16: Packaging and Yield

Wafer thinning and die separation, Epoxy die attachment, Eutectic die attachment, Thermocompression bonding, Ultrasonic bonding, Thermosonic bonding, Circular TO-style packages, Dual-in-line packages, Pin-grid arrays, Leadless chip carriers, Flip-chip technology, Ball grid array, Yield: uniform defect densities, nonuniform defect densities