

SOLID STATE POWER DEVICES

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EECS498, special topics

Monday and Wednesday: 12-1:30pm

Fridays, discussion class: 1:30 - 2:30pm,

Power semiconductor devices are at the heart of modern power electronic systems, and are expected to play an increasingly large role in reducing energy losses and in adapting power systems to new energy sources, especially renewable sources of energy. The goal of this course is to prepare students to analyze and design semiconductor devices and smart power integrated circuits for low and high power applications with different materials and technologies.

The course covers the physics and fabrication of various power devices, whose capabilities span a broad range of voltages, currents and switching speeds. Of course, special attention is paid to Insulated Gate FET devices, which in addition to being commonly used in conventional digital and analog circuits, are also the devices of choice for power electronics.

We start the course with a broad review of ideal power devices, semiconductor material properties, breakdown voltages and a detailed analysis of PN junctions along with the analysis and fabrication of power diodes, Schottky and pin diodes. The physics and fabrication process of basic MOS structures will be covered in detail along with the fabrication technology of different power MOS transistors. Bipolar Junction transistors and their combination with MOS technology, which has resulted in Insulated Gate Bipolar Transistors, will also be covered in this course. JFET based power devices are another group of devices that is under development and research, and will also be covered. Then the physics and fabrication of four and higher layer devices will be discussed, including SCR, GTO, and MCT devices. Temperature effects and packaging are other important issues in power devices that will also be discussed in this course, along with the fabrication of devices with large band gap materials like SiC and GaN.

Prerequisite: EECS320, or graduate standing.