Electrical characterization of semiconductor materials and devices
5 points
Graduate course at IFM Spring 2012

Purpose:
This course is intended for Ph.D. students with at least some background in semiconductor physics and devices from undergraduate courses. The focus here is on electrical characterization of both semiconductor materials and devices. The purpose is twofold. Firstly the course handles how Ohmic and Schottky contacts are made on semiconductors and how we judge their quality prior to using them to probe the properties of the semiconductor itself. The second focus is on understanding the various electrical characterization techniques that are used to study carrier concentrations, dopants and deep level defects in semiconductor structures. The techniques are demonstrated for bulk and epilayers but we also discuss how to use them for low dimensional structures and nanostructures.

Lectures: 10 x 90 min lectures will be given during the spring of 2012, starting in January and ending in early May.

Examination: is based on four homework packages that will be turned in and reviewed during the course (see more info below). Each student will also present an individual project work during the course.

Examiner/Lecturer: Einar Sveinbjörnsson, Guest Professor (now and then at IFM), email: einars@hi.is or einsv@ifm.liu.se

Course material: The course covers some parts of the book „Semiconductor Material and Device Characterization“ by Dieter K. Schroder, Wiley-Interscience, 3rd edition 2006. Older editions of this book can also be used. In addition some articles and handouts will be distributed during the course.

Course content: (preliminary)
Ohmic and Schottky contacts to semiconductors (theory and practice). Analysis of resistivity, carrier- and doping concentrations using C-V, I-V, admittance spectroscopy, Hall, four-point probe and contactless methods. Space charge techniques to study deep levels in semiconductors (bulk, epilayers and low dimensional structures when applicable) such as Deep Level Transient Spectroscopy and other related transient techniques.
Lecture schedule: (preliminary)
8. DLTS on troublesome non-bulk structures, like heterostructures, quantum dots and nanostructures. Week 13 2012.

Homework (preliminary):
Homework is to be turned in during the course. The four assignments include reading selected course material and solve specific problems. The topics are:
1. Schottky and ohmic contacts. Turn in week 5 2012.
3. Recombination and generation and the birth of DLTS. Turn in week 12 2012.
4. DLTS on „practical“ structures. Turn in week 16 2012.

Individual project: will be assigned during the course. The student reads (and understands) a published journal paper or solves a specific problem and gives a 15 min lecture on the topic. The dates for the lectures will be decided during the course.