6.730 PHYSICS FOR SOLID STATE APPLICATIONS

Department of Electrical Engineering and Computer Science
Massachusetts Institute of Technology

PROBLEM SET 7

Issued: 4-21-99 Due: 4-26-99, at the beginning of class.

Readings:
PSSA Chapter 9 and 10

Problem 7.1 A Work Function Thickness Monitor? (former quiz problem).

Two thin slabs of aluminum, each having dimensions $10\,\mu\text{m} \times 10\,\mu\text{m}$ are positioned parallel to each other, separated by a distance of $1000\,\text{Å}$. They are electrically connected to each other through an ammeter using copper wires. A short pulse of gold atoms, enough to create a coating about $10\,\text{Å}$ thick, is directed toward the gap between the plates at a grazing angle so that the gold atoms only strike the surface of the lower plate.

In principle, is it possible to detect the arrival of the pulse of gold atoms with the ammeter?

Explain your answer. If you decide that the answer is yes, then indicate which way the current must flow through the ammeter (lower-to-upper, or upper-to-lower), and estimate the total area under the current pulse (that is, estimate the total charge transfer that results from the arrival of the gold).

Problem 7.2

An abrupt heterojunction is constructed from two semiconductors having the following data:

	Semiconductor 1	Semiconductor 2
Electron Affinity	$2.0\,\text{eV}$	$2.5\,\text{eV}$
Band gap	$1.8\,\text{eV}$	$1.1\,\text{eV}$
Doping	$N_A = 10^{17}\,\text{cm}^{-3}$	$N_D = 10^{15}\,\text{cm}^{-3}$
$N_V = N_C$	$10^{19}\,\text{cm}^{-3}$	$10^{18}\,\text{cm}^{-3}$

Make a sketch of the bands at equilibrium. Show important features of the band structure in the vicinity of the junction, and show the position of the Fermi level relative to the band structure in each semiconductor.

Problem 7.3 *Band Bending*

Do problems from SSS from Possion simulation.

Problem 7.4 *Electrons and Holes*

Do problems from SSS from Pierls simulation.