Physics 489 S 04 Lecture 23
Semiconductors II: Inhomogeneous Structures
A & M Ch. 29, Kittel Ch. 19, latter part

1. Semiconductor structures are formed by:

   (a) Controlled doping with foreign atoms. Different in different regions.

   (b) Growth of crystals with inhomogeneous composition

   (c) Variations of electron and hole energies by applied electric fields

2. Quantum Wells
   Created in crystals of alloys (Ga,Al)As: Example a GaAs layer in AlAs
   The conduction (valence) band edge is lower (higher) in GaAs layer the in AlAs outside layer
   Creates confined state. Simple problem with m^* for electrons.
   For a square well of width l and an infinite barrier height, quantized energies are
   $E_n = E_0 + (\hbar^2/2m^*)(n^2\pi^2 l^2 + k_x^2 + k_y^2)$
   Carriers inside the layer act like a 2-d metal if T $<<$ level spacing
   Parabolic well considered in problem set
   Can make Quantum Dots, ...

   See hand-drawn figures in notes

3. p-n junction rectifier

   See hand-drawn figures in notes

4. Shottky Barrier rectifier

   See hand-drawn figures in notes

5. Transistor: p-n-p; n-p-n; injection of minority carriers across thin base region

   See hand-drawn figures in notes

6. MOS structure (Field Effect Transistor)

   See hand-drawn figures in notes

   This is the original device used in the Quantized Hall Effect. Semiconductor structures are a laboratory for creating interesting metals!