Homework #7 — EE528

due 11/24/08

1. Problem 9.5 in text.
2. Consider sputter deposition over a single vertical 100nm step. Assume that the sputtering target is large and is at a distance of 10cm from the wafer. Further assume that the sputtered atoms have a $\cos\theta$ angular distribution and that the mean free path is large compared to the system size.
   (a) What is the ratio of the film deposition rate on the lower horizontal surface immediately adjacent to the step compared to that far away from the step?
   (b) What is the ratio of the film deposition rate on the vertical surface of step compared to that on a horizontal surface far away from the step?
3. Consider deposition of polysilicon in a hot-wall LPCVD reactor at 600°C via silane pyrolysis ($SiH_4 \rightarrow Si + 2H_2$). The supply gas flows are 2 slpm of SiH_4 and 6 slpm of H_2. The interface reaction rate constant is $5 \times 10^8 \exp(-1.6\,\mathrm{eV}/kT)$ cm/sec. The total system pressure is 0.5 Torr. The tube diameter is 25 cm and the wafer diameter is 20 cm. The reactor furnace has 100 wafers spaced at a distance of 0.5 cm.
   (a) Calculate the deposition rate for the front wafer. Assume that the reverse (etching) reaction and the reduction in silane concentration due to wall deposition in the hot zone prior to the first wafer can be ignored.
   (b) What pure silane flow rate per unit tube length would be required in a distributed feed system to keep the deposition rate constant along the length of the tube?
4. Using the Sentaurus Alagator scripting language (see Chapter 6 of manual), simulate the system considered in Problem 2 on Homework 4.