EE486 Integrated Circuit Fabrication
Spring 2017

Homework 6
Due in class on Wednesday, May 24, 2017

1. Consider sputter deposition over a single vertical 50nm step. Assume that the sputtering target is large and is at a distance of 5 cm 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?

2. Identify the which type(s) of etch equipment should be used if the following are the biggest concern:

   (a) Selectivity.

   (b) Ion bombardment damage.

   (c) Vertical sidewalls.

   (d) Selectivity and vertical sidewalls.

   (e) Selectivity and vertical sidewalls and damage, while maintaining relatively rapid etch rate.

3. If the anisotropy of an etch process is 0.45, sketch the etch profile. What percentage of the etch rate in the vertical direction is due to the chemical component and what percentage is ionic/physical, assuming a linear etch mechanism? State all assumptions. Compare your answer to Sentaurus simulation.

4. We want to see how the etch rate in the vertical direction might depend on pressure assuming that the etch follows the simple saturation/adsorption model (equation in notes). Assume that for this particular etch system the chemical flux is directly proportional to the pressure, while the ion flux is inversely proportional to the pressure. That is $F_c=F_c'*P$ and $F_i=F_i'/P$. (P is normalized to 1 atm and unitless.) Also assume that density = 40 atom nm^{-3}, and that $K_iF_i' = 10^{-5}$ atom nm^{-2} sec^{-1} and $S_cF_c' = 10^5$ atom nm^{-2} sec^{-1}.

   (a) Calculate the vertical and lateral etch rates versus pressure.

   (b) Plot the vertical etch rate, lateral etch rate and etch anisotropy versus pressure, P, from $P = 10^{-6}$ to 10^{-3} (use log-log scales).