3.155J/6.152J
Microelectronic Processing
Fall Term, 2005

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Problem Set 5 Out Oct. 22, 2005 Due Nov.2, 2005

1. The Matrix Asher you use in the lab to remove photoresist from your wafers works using an oxygen plasma at a pressure of order 1 Torr. This pressure is higher than the plasma conditions for sputter deposition that we considered in class where the pressure range over which we plasmas were found to be stable was about from 1 mT to 100 mT.

a) Calculate the mean free path of an oxygen ion at 1 Torr assuming T = 300 K. (http://www.iun.edu/~cpanhd/C101webnotes/modern-atomic-theory/atomic-radii.html).

b) Briefly describe the nature of the oxygen ions and the voltage needed to insure that they gain sufficient energy to ionize oxygen atoms? Discuss.

2. A typical dry CVD growth rate for gate-oxide-quality SiO_2 is about 0.1 μm/hr. For a special project, you consider that instead of dry CVD you will try reactive evaporation (evaporate Si while chamber is backfilled with a partial pressure of oxygen gas). Being cautious, you pump your chamber down to 10^{-7} T and do not backfill the chamber with any O_2 until you can measure the Si deposition rate.

a) Estimate the Si deposition rate if you heat the Si source to 1500 K and the chamber geometry is: crucible opening radius is 2 cm, chamber r = 30 cm (r defined in class notes).

b) What partial pressure of O_2 would you need to use in order that the Si film grown under these conditions is fully oxidized (assume unit sticking and 100% reaction).

c) What changes would you make to better compete with CVD?