PROBLEM SET #1

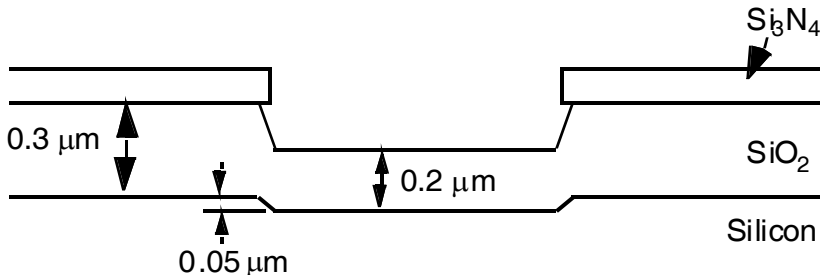
Issued: Tuesday, Sept. 11, 2007

Due (at 5 p.m.): Tuesday, Sept. 18, 2007

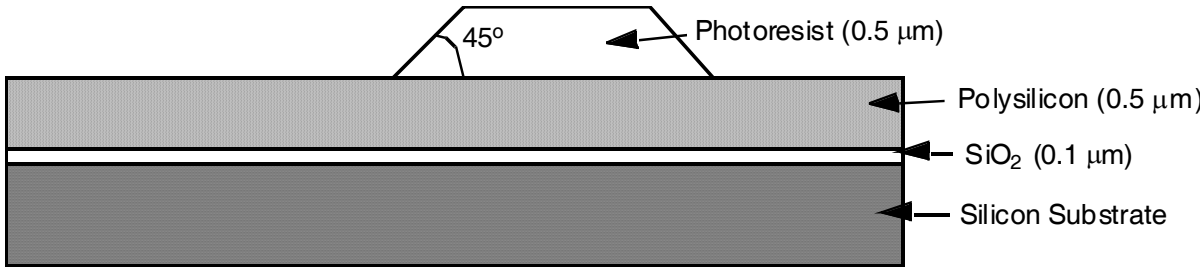
1. The structure shown below has gone through the following process steps:

(i) Start with a bare ⟨100⟩ silicon wafer.
(ii) Grow 3000 Å of oxide.
(iii) Deposit 1000 Å of Si_3N_4.
(iv) Mask 1.
(v) Etch 1000 Å of Si_3N_4 and *m* Å of SiO_2.
(vi) Wet oxidation @ 1000°C for *t* minutes.

Determine *t* and *m*.



2. The cross-section of a polysilicon-oxide-silicon substrate sandwich structure with a photoresist pattern on top is shown. The pattern will be etched in a plasma. You can assume that the etching is 100% anisotropic; that the selectivity of silicon (and polysilicon):SiO_2:photoresist = 2:1:1; and that the etch rate of silicon (and polysilicon) is 0.1 μm/min. Carefully draw cross-sections of the structure after (a) 2 minutes of etching; (b) 5 minutes of etching; and (c) 11 minutes of etching. Be sure to specify relevant angles and dimensions for each cross-section.



3. Figures (a) through (c) below present top view layouts of three different silicon structure designs to be constructed using anisotropic wet etching. The white regions denote areas where an oxide mask is present. The green (or darker, if you're printing in black & white) regions denote areas of open undoped silicon, where oxide has been removed by etching. The wafer types and flat orientations are also indicated in each figure. Suppose we use an ideal anisotropic wet etchant that has a finite etch rate for all planes except for (111) planes, which are not etched at all. Draw top views and cross-sections along A-A′ (and B-B′, for (c)) for each layout after a very long time (i.e., infinite amount of time) in this etchant. Indicate relevant dimensions and angles in your drawings.