Silicon Photonics Homework #5

HW 5-1. The following figure is a series of photolithographical steps to form a rib waveguide on a SOI wafer with a silicon overlayer of 3 μm and a buried oxide of 0.5 μm. Assume that the pattern is a 3.5 μm wide metal strip on the quartz photo-mask. A positive photoresist (PR) is used. The etching rate of the silicon is 0.1 μm/min. The dry etching is performed for 13 minutes.

(a) Please plot the cross-sectional view after the development of the PR.

(b) If there is no pattern shrinkage during the dry etching process. Please plot the cross-sectional view after the dry etching of silicon is completed and the PR is removed (please specify the width, height of the rib and the height of the etched side region of the rib waveguide).

(c) Does the rib waveguide in (b) satisfy the single-mode condition? Why?

(d) If the additional pattern shrinkage of 1 μm on the rib width is considered during the dry etching process. Please plot the cross-sectional view after the dry etching of silicon is completed and the PR is removed (please specify the width, height of the rib and the height of the etched side region of the rib waveguide).

(e) Does the rib waveguide in (d) satisfy the single-mode condition? Why?

HW 5-2 Please calculate the effective index of the TE mode in the rib waveguide fabricated in HW5-1(d). (n_{slicon}= 3.5, n_{SiO2}=1.5, n_{air}=1.0)