

EE 243: ADVANCED IC PROCESSING AND LAYOUT

Homework Assignment #7 (Due April 2 Wed)

Reading Assignment :

PDG, Chap 5

Handouts – Sheats and Smith Chap 3

Problem 1 Dill's Model of Resist Exposure – A,B,C parameter extraction

Given:

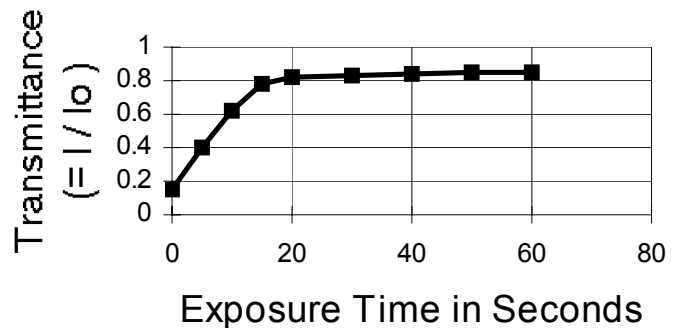
$$\frac{\partial I(z,t)}{\partial z} = - [Am(z, t)+B] I (z, t)$$

$$\frac{\partial m(z,t)}{\partial t} = - C I (z, t) m(z, t)$$

where m is the normalized concentration of inhibitor in positive resist.

Optical transmission experiment shows the following transmittance (I/I_0) versus exposure time curve for a 2.2 micron positive resist. (AZ1350J). Find numerical values for the bleachable absorption parameter A, the nonbleachable absorption parameter B, and the bleaching rate C. The I_0 value is $30\text{mJ}/\text{cm}^2\text{-sec}$.

The T_{12} factor (air-to-resist) is 0.8.



Problem 2 Resist standing waves

With i-line (365nm) exposure,

Shipley AZ 1470 resist has $n = 1.7-j0.032$

Si substrate has $n = 6.52 -j2.71$

- Determine the period (min-to-min exposure) of the standing waves at i-line.
- Find the reflection coefficient from silicon seen in the resist at i-line
- Determine the magnitude of the reflection coefficient $|\rho|$ seen from within the resist that a bottom antireflection coating (BARC) layer must produce to make the vertical contrast C_{VERTICAL} equal 0.2.

[Hint: First, find the ratio $I_{\text{MAX}}/I_{\text{MIN}}$, which give the required C_{VERTICAL} . Then find $|\rho|$ by setting $1+|\rho| = \text{sqrt}(I_{\text{MAX}}/I_{\text{MIN}}) (1 -|\rho|)$]

Problem 3 Resist Profile Simulation

In LAVA go to simulators and select SAMPLE-2D. Remove the Develop_Rate_2 row and insert the Develop_Rate_3 row to switch to the Mack model.

Input the refractive index for silicon at i-line, the ABC values, 365 nm, $NA=0.32$, $\sigma = 0.5$ and your development model with 60s development time. Use a line equal space pattern with period =2 um.

- Find a dose to clear the resist in 60s development time and note the resist profiles.
- Adjust the dose so that the resist breaks through to the Si surface with 20s development time.