AEP 711
Problem Set 2
4/4/2002

Part a See attached Matlab code for calculation details. The data for the bilayer is indeed seen to fall off like the Fresnel reflectivity for Pd (see Fig 1. The elements of the 2x2 transfer matrix for the interface at $z_{i,i+1}$ are developed as:

$$\begin{aligned} a_i &= \frac{1}{2}\left[1+\frac{k_{z,i+1}}{k_{zi}}\right]\frac{E_a}{E_b}a_{i+1} + \frac{1}{2}\left[1-\frac{k_{z,i+1}}{k_{zi}}\right]\frac{E_a^*}{E_b}b_{i+1} \\ b_i &= \frac{1}{2}\left[2E_b - \left[1+\frac{k_{z,i+1}}{k_{zi}}\right]\right]\frac{E_a}{|E_b|^2}a_{i+1} + \frac{1}{2}\left[2E_b + \left[1+\frac{k_{z,i+1}}{k_{zi}}\right]\right]\frac{E_a^*}{|E_b|^2}b_{i+1} \end{aligned}$$

Rearranging into a matrix equation, we can write $\lfloor a_i \quad b_i \rfloor = \lfloor a_{i+1} \quad b_{i+1} \rfloor \underline{\mathrm{A}}^T$ where

$$\begin{aligned} A_{i,i+1,11} &= \frac{1}{2}\left[1+\frac{k_{z,i+1}}{k_{zi}}\right]\frac{E_a}{E_b} \\ A_{i,i+1,12} &= \frac{1}{2}\left[1-\frac{k_{z,i+1}}{k_{zi}}\right]\frac{E_a^*}{E_b} \\ A_{i,i+1,21} &= \frac{1}{2}\left[2E_b - \left[1+\frac{k_{z,i+1}}{k_{zi}}\right]\right]\frac{E_a}{|E_b|^2} \\ A_{i,i+1,22} &= \frac{1}{2}\left[2E_b + \left[1+\frac{k_{z,i+1}}{k_{zi}}\right]\right]\frac{E_a^*}{|E_b|^2} \end{aligned}$$

and

$$\begin{aligned} E_a &\equiv e^{ik_{zi}z_{i,i+1}} \\ E_b &\equiv e^{ik_{z,i+1}z_{i,i+1}} \end{aligned}$$

Part b The data is left unormalized.

Part c The optimal σ is visually found to be ≈ 4.1

Part d The optimal values for t_{Pd} and t_{Cr} to be 199Å and 58Å, respectively. Admittedly, I searched a little beyond 10% for Δt_{Cr} but it seemed to have a favorable result.

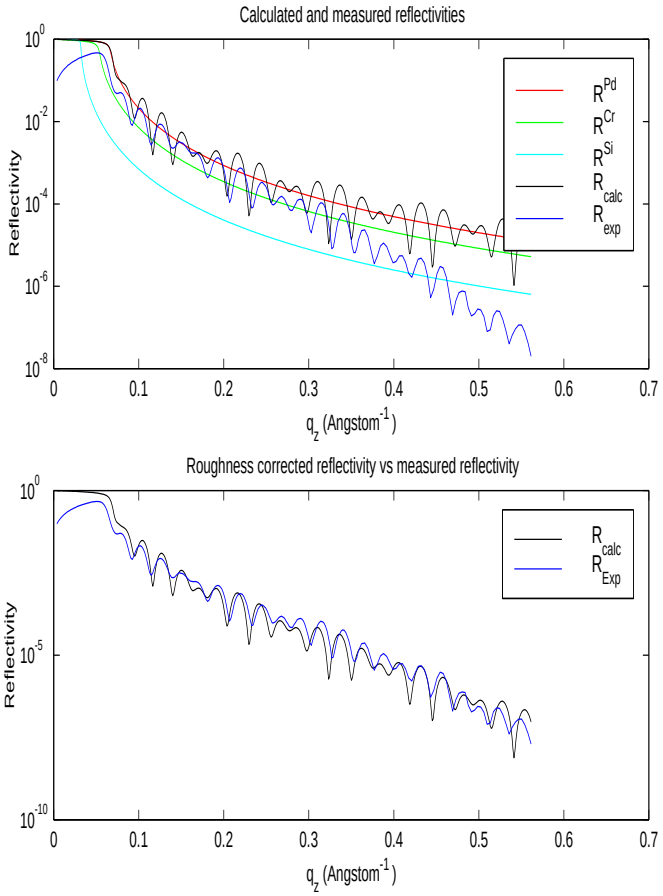

Figure 1: Plots of the calculated reflectivities vs measured data.