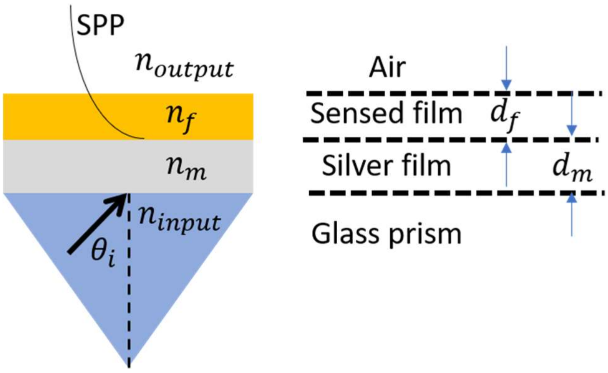
LAB EXERCISE: Plasmonic biosensor

Use the MATLAB function “tmm.m” to analyze and design a plasmonic biosensor in the Kretschmann configuration, as described in the figure below. The bio-nanofilm has a refractive index $n_f = 1.33$. The goal is to analyze the sensitivity of the device with respect to changes of the bio-nanofilm thickness (and refractive index).



- Input medium: glass, $n_{input} = 1.5$
- Output medium: air, $n_{output} = 1$
- Wavelength: 532 nm
- Angle of incidence θ_i is variable
- Metal film: relative permittivity $\epsilon_m = -10 - j1$; thickness $d_m = 40$ nm
- Refractive index of the bio-nanofilm, $n_f = 1.33$
- Thickness of the bio-nanofilm d_f is variable

Step 1. Plot the reflectance as a function of angle of incidence when the nanofilm is absent, i.e., $d_f = 0$. Take note of the angle at which the reflectance dip occurs. Write the value in the table below.

Step 2. Repeat Step 1 introducing the bio-nanofilm. Consider the film thicknesses reported in the table’s first column and fill the rest of the table.

d_f	θ_{dip}
0 nm	
10 nm	
20 nm	
30 nm	
40 nm	
50 nm	
60 nm	

Step 3. Study the linearity of the biosensor. Is θ_{dip} varying linearly with respect to d_f?

Step 4. Find an approximate value of the **sensitivity of the SPP biosensor** calculated as $S = \Delta\theta_{dip}/\Delta d_f$.