Measuring the reflectance spectra of the 5 semi-transparent conducting samples:

Background: Although you are able to measure the transmission spectra at normal incidence (the case for which the reflected light bounces directly back upon the incident light beam), making a reflectance measurement at normal incidence is not so easy. Therefore, you can make the reflectance measurement at an angle of incidence (you should carefully estimate this angle) sufficiently close to normal incidence so that the reflectance is nearly identical to that at normal incidence.

Unless specifically polarized, light consists of a mixture of polarizations that can be considered partially "p" polarized and partially "s" polarized. The polarization of light indicates the direction of the electric field oscillations as the wave travels along at the speed of light, and the electric field is always perpendicular to the direction of travel. Because a monochromator preferentially transmits one polarization of the other, we can not know for certain the polarization mixture (s and p) of the output of the CM110.

Here's how to distinguish s- and p-polarized light. First of all, the *plane of incidence* is defined by the incident, refracted, and reflected light rays for a planar surface. One can think just about the incident and reflected rays (or beams), which together define the plane of incidence. OK, we know that the (oscillating, at a frequency given by c/λ) electric field has a direction perpendicular to the direction of travel. We can then define two distinct (and orthogonal) polarizations of light relative to the plane of incidence: one is the case where the incident light is polarized *parallel* to the plane of incidence (this is p-polarized light). The other (you'll guess this) is the case for which the light is polarized *perpendicular* to the plane of incidence (this is s-polarized light). FYI, p arises from parallel, and s arises from the German word *senkrecht* (perpendicular).

At normal incidence, the reflectance at an interface between two non-absorbing media is given by $R = [(n1-n2)/(n1+n2)]^2$. Plugging in the refractive indices of air (1.00) and glass (1.5), once finds that R = 0.04 for each air-glass interface. Therefore, the approximate reflectance of an uncoated glass slide is 0.08, or 8%. The equations for the reflection coefficient for s and p light are given below [http://en.wikipedia.org/wiki/Fresnel_equations]; you should use your estimated angle of incidence (careful on how you define this angle – i.e., define it correctly) to determine the values of R_s and R_p (don't confuse R_s with sheet resistance – in this case it means the reflection coefficient for s-plane polarized light). The variation in R for s and p (at your specific angle of incidence) will provide you with an estimate of the uncertainty in the measurement of $R(\lambda)$ for the uncoated glass slide. [Note that you do not need to distinguish between s and p polarized light when you measure the reflectance spectra of the uncoated glass slide and of your 5 samples.] This measurement (of the reflected signal amplitude vs. wavelength) of the uncoated glass slide is critical for a careful determination of the actual reflectance spectra $R(\lambda)$ for the 5 samples. In essence, you'll use your known value of R for uncoated glass to determine $R(\lambda)$ for the other 5 samples.

$$R_s = \left(\frac{n_1\cos\theta_i - n_2\cos\theta_t}{n_1\cos\theta_i + n_2\cos\theta_t}\right)^2 = \left[\frac{n_1\cos\theta_i - n_2\sqrt{1-\left(\frac{n1}{n2}\sin\theta_i\right)^2}}{n_1\cos\theta_i + n_2\sqrt{1-\left(\frac{n1}{n2}\sin\theta_i\right)^2}}\right]^2$$

$$R_p = \left(\frac{n_1\cos\theta_t - n_2\cos\theta_i}{n_1\cos\theta_t + n_2\cos\theta_i}\right)^2 = \left[\frac{n_1\sqrt{1-\left(\frac{n1}{n2}\sin\theta_i\right)^2} - n_2\cos\theta_i}{n_1\sqrt{1-\left(\frac{n1}{n2}\sin\theta_i\right)^2} + n_2\cos\theta_i}\right]^2$$