Surface Plasmon Resonance

Your primary goals for this lab are:

(1) To understand how classical physics explains SPR in terms of Maxwell's equations and Newton's Laws.

(2) To understand how quantum physics explains SPR in terms of phtons and surface plasmons.

(3) To understand that many-body systems can often be described extremely well in terms of quasi-particles. In this case, the collective oscillations of the electron gas at the surface of the silver sample can be described very well in terms of surface plasmon quasiparticles. Of course, the most famous example is the collective excitations of the atomic vibrations in the lattice, which can be described very well in terms of phonon quasi-particles. Plasmons and phonons aren't really particles---they are collective excitations of the electron gas and of the lattice, respectively---but they are described very well in terms of quantum mechanical "particle-waves" called quasi-particles which allow us to express the conservation of energy and momentum in a very simple fashion.

(4) To understand how these reflectivity curves depend on the real and imaginary components of the complex valued dielectric constant, and on the thickness, of the silver film.

(5) To understand the connection between the complex valued dielectric constant and the complex valued index of refraction, and to understand how these two quantities are related to the reflection and the absorption of light by the silver film.

(6) To measure the reflectivity versus incidence angle of a silver film in the ATR (attenuated total reflection) geometry at two HeNe laser wavelengths (red and green), and to understand the measured reflectivity in terms of the excitation of surface plasmons in the silver film.

(7) To repeat the measurements in part 6 for a range of LED wavelengths.

Day One: Learn how to take data, and then measure the SPR curve for the red laser. Calculate the SPR curve. Change the real part of the complex dielectric constant, the imaginary part of the complex dielectric constant, and the thickness of the silver film in the analysis program and document how each one changes the SPR curve.

Day Two: Repeat the measurements and the analysis that you did on Day One using the green laser.

Day Three: Repeat the measurements and the analysis that you did on Day One using the LEDs.

In your lab report: Explain the physics specified in the goals section above. Present your measurements and your best fits to them. Explain how well your values compare to the literature values.