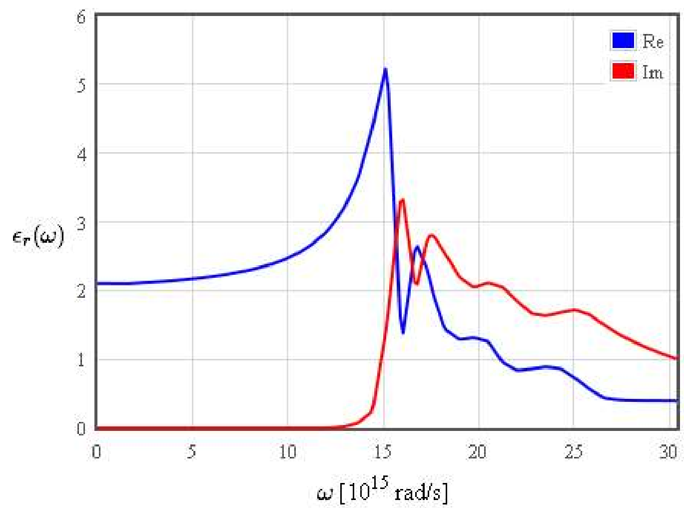
The optical properties of SiO_2 (glass)

nanophotonics.csic.es

Dielectric function

The relative dielectric constant describes the relationship between the electric displacement $\vec{D}$ and the electric field $\vec{E}$, $\vec{D} = \epsilon_r \epsilon_0 \vec{E} = \vec{P} + \epsilon_0 \vec{E}$.

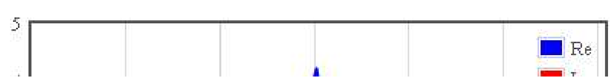


There are two conventions for dielectric function. Either it is assumed that the time dependence of $\vec{D}$, $\vec{P}$, and $\vec{E}$ is $\exp(-i\omega t)$ and the plot of the dielectric function looks as it is shown above, or it is assumed that the time dependence of $\vec{D}$, $\vec{P}$, and $\vec{E}$ is $\exp(i\omega t)$ and the imaginary part of the has the opposite sign as in the plot above. Here we will assume a time dependence of $\exp(-i\omega t)$.

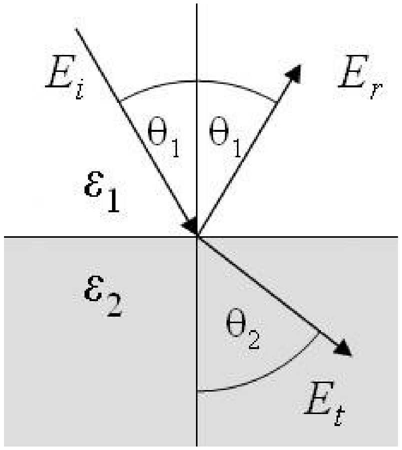
Electric susceptibility

The electric susceptibility χ_E describes the relationship between the polarization $\vec{P}$ and the electric field $\vec{E}$, $\vec{P} = \epsilon_0 \chi_E \vec{E}$.

$$\chi_E = \epsilon_r - 1$$



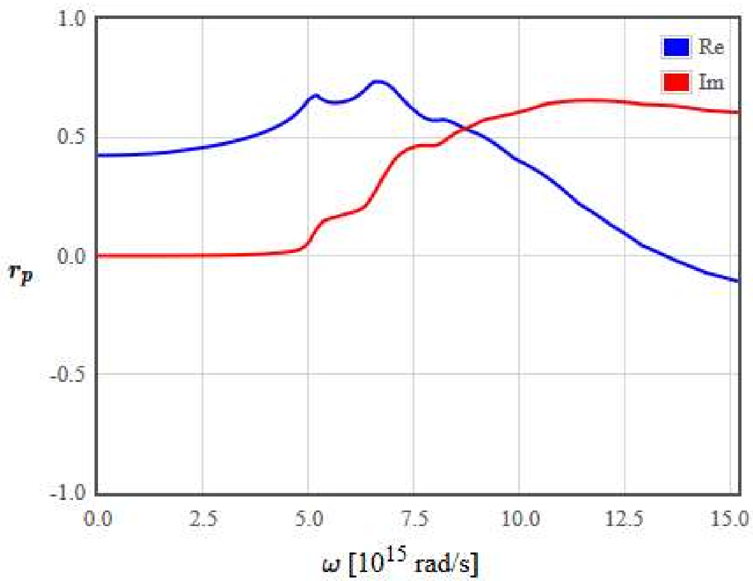
Ellipsometry

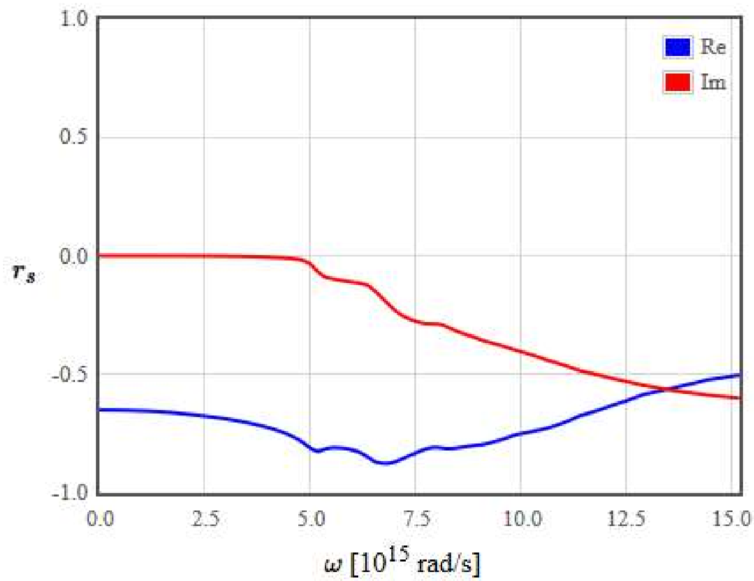


$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

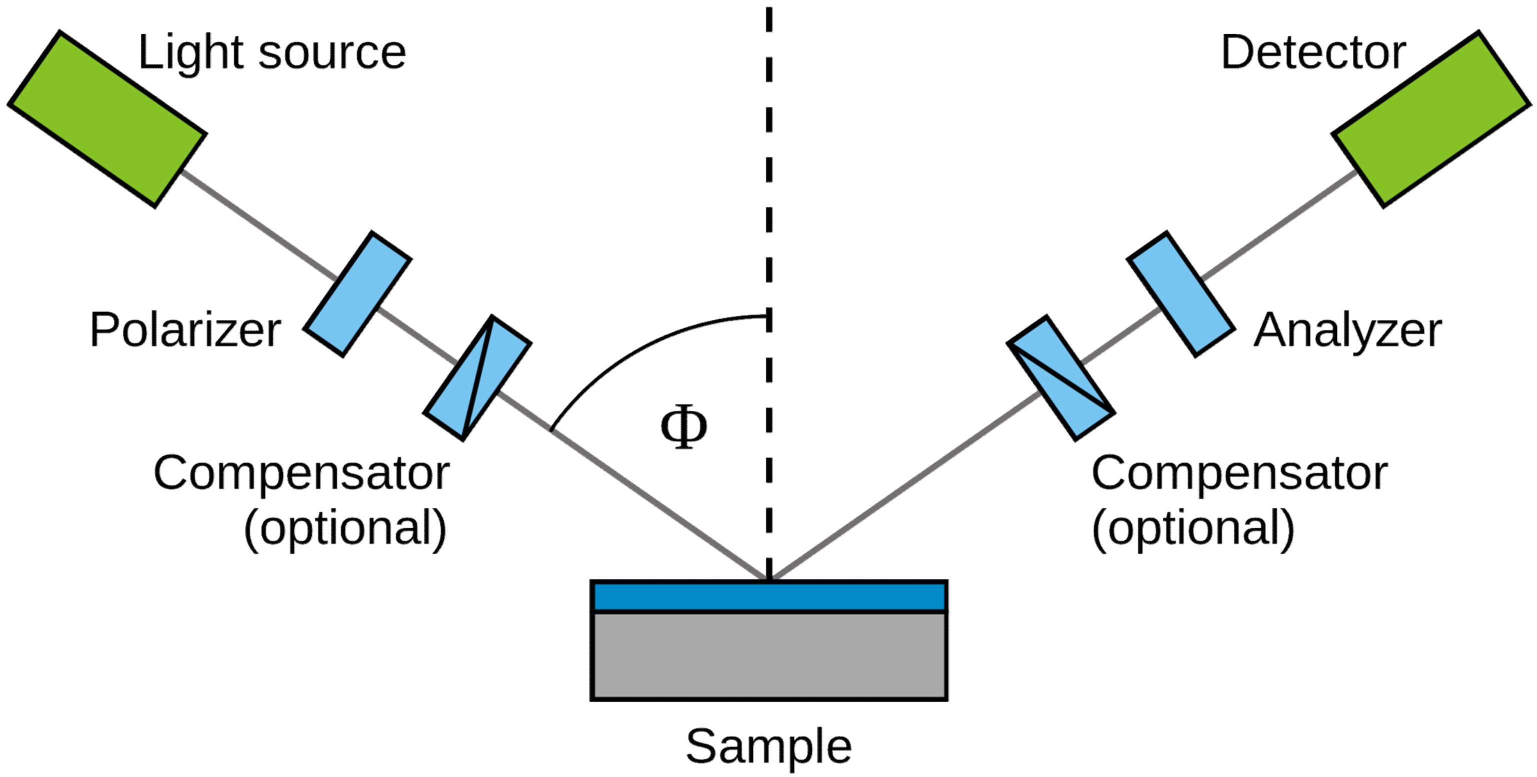
$$r_p = \frac{E_{rp}}{E_{ip}} = \frac{\sqrt{\epsilon_2}\cos\theta_1 - \sqrt{\epsilon_1}\cos\theta_2}{\sqrt{\epsilon_2}\cos\theta_1 + \sqrt{\epsilon_1}\cos\theta_2}$$

$$r_s = \frac{E_{sr}}{E_{si}} = \frac{\sqrt{\epsilon_2}\cos\theta_2 - \sqrt{\epsilon_1}\cos\theta_1}{\sqrt{\epsilon_1}\cos\theta_1 + \sqrt{\epsilon_2}\cos\theta_2}$$





Ellipsometry

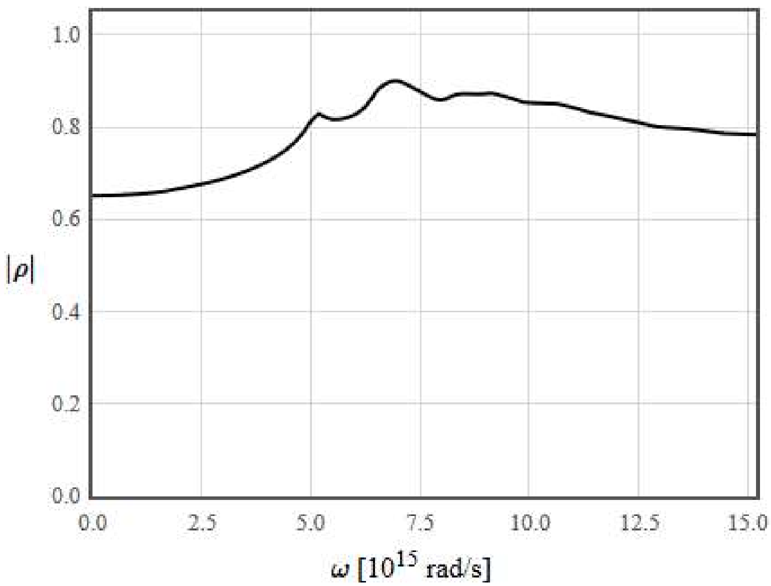


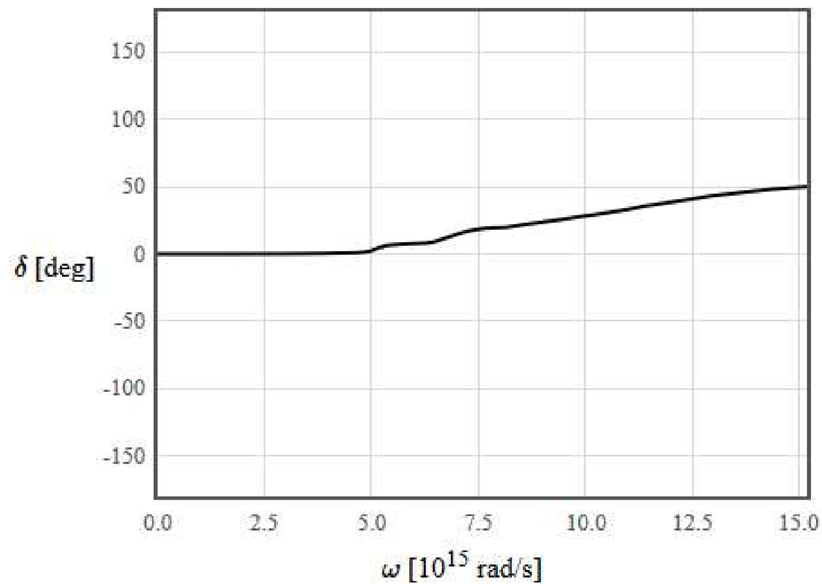
Ellipsometry measures the change of polarization upon reflection. The measured signal depends on the thickness and the dielectric constant.

http://en.wikipedia.org/wiki/Ellipsometry

Ellipsometry

$$\rho = \frac{r_p}{r_s} = |\rho| e^{i\delta}$$





The ratio of the two reflected polarizations is insensitive to instabilities of light source or atmospheric absorption.