Dispersion formulas (for metal)

All quantities (except dimensionless numbers) are expressed in unit of eV.
In this case, the angular frequency ω is expressed by the vacuum wavelength $\lambda[\mu\mathrm{m}]$ as

$$\omega[\mathrm{eV}] = \frac{hc}{e} \times 10^6 \frac{1}{\lambda[\mu m]}.$$

The refractive index n and extinction coefficient k is given by

$$n = \mathrm{Re}\sqrt{\varepsilon},$$

$$k = \mathrm{Im}\sqrt{\varepsilon},$$

Where ε is the dielectric function given by one of the following formulas.

1: Drude-Lorentz model

$$\varepsilon(\omega) = \varepsilon_b - \frac{f_0 \omega_p^2}{\omega(\omega + \mathrm{i}\Gamma_0)} - \sum_{j=1}^{5} \frac{f_j \omega_p^2}{\omega^2 - \omega_j^2 + i\omega\Gamma_j}.$$

In this case, coefficients are defined by

$$\{C_n\} = \left\{\varepsilon_b, f_0, \omega_p, \Gamma_0, f_1, \omega_1, \Gamma_1, f_2, \omega_2, \Gamma_2, \cdots\right\}.$$

2: Brendel-Bormann model

$$\varepsilon(\omega) = \varepsilon_b - \frac{f_0 \omega_p^2}{\omega(\omega + \mathrm{i}\Gamma_0)} + \mathrm{i}\frac{\sqrt{\pi}}{2\sqrt{2}} \sum_{j=1}^{5} \left[\frac{f_j \omega_p^2}{\sqrt{\omega(\omega + \mathrm{i}\Gamma_j)}\sigma_j} \left\{ w\left(\frac{\sqrt{\omega(\omega + \mathrm{i}\Gamma_j)} - \omega_j^2}{\sqrt{2}\sigma_j} \right) + w\left(\frac{\sqrt{\omega(\omega + \mathrm{i}\Gamma_j)} + \omega_j^2}{\sqrt{2}\sigma_j} \right) \right\} \right],$$

Where $w(z)$ is the error integral of the complex argument

$$w(z) = \mathrm{e}^{-z^2} \mathrm{erfc}(-iz) \quad (\mathrm{Im}[z] > 0),$$

With $\mathrm{erfc}(z)$ is the complementary error function,

$$\mathrm{erfc}(z) = \frac{2}{\sqrt{\pi}} \int_z^{\infty} \exp(-t^2)\,\mathrm{d}t.$$

In this case, coefficients are defined by

$$\{C_n\} = \left\{\varepsilon_b, f_0, \omega_p, \Gamma_0, f_1, \omega_1, \Gamma_1, \sigma_1, f_2, \omega_2, \Gamma_2, \sigma_2, \cdots\right\}.$$