

Optics: gain/absorption calculation

Permittivity and gain/absorption

The bulk relative permittivity, or dielectric constant, is assumed to be given by the [Lyddane-Sachs-Teller relation](#):

$$\epsilon^{\text{bulk}}_r(\omega) = \epsilon_{\infty} + (\epsilon_{\infty} - \epsilon_{\text{static}}) \frac{\omega_{\text{TO}}^2}{\omega^2 - \omega_{\text{TO}}^2}$$

In the self-consistent gain calculation, the quantity which is actually calculated is the a.c. conductivity $\sigma(\omega)$.

The complex relative permittivity which is output is then:

$$\epsilon_r(\omega) = \epsilon^{\text{bulk}}_r(\omega) - i \frac{\sigma(\omega)}{\omega \epsilon_0}$$

Finally the gain reads

$$g(\omega) = -\frac{\text{Re}(\sigma(\omega))}{\epsilon_r(\omega)}$$

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