Answer on Question #60463, Physics / Optics

A plane e.m. wave is incident normally on an interface. Obtain expressions for reflection and transmission coefficients.

Solution:

Fresnel formulas

The reflectance coefficient for *s*-polarized light:

$r_s = \frac{n_1 \cos\theta_i - n_2 \cos\theta_t}{n_1 \cos\theta_i + n_2 \cos\theta_t}$ (1),

where n_1 – absolute refractive index of light by the first environment,

n_2 – absolute refractive index of light by the second environment,

θ_i – angle of inddence,

θ_t – angle of refraction

The reflectance coefficient for *p*-polarized light:

$r_p = \frac{n_2 \cos\theta_i - n_1 \cos\theta_t}{n_2 \cos\theta_i + n_1 \cos\theta_t}$ (2)

Normal drop of wave:

$\theta_i = 0°$ (3)

$\theta_t = 0°$ (4)

(3) and (4) in (1): $r_s = \frac{n_1 - n_2}{n_1 + n_2}$ (5)

(3) and (4) in (2): $r_p = \frac{n_2 - n_1}{n_2 + n_1}$ (6)

The transmission coefficient for *s*-polarized light:

$t_s = \frac{2n_1 \cos\theta_i}{n_1 \cos\theta_i + n_2 \cos\theta_t}$ (7)

(3) and (4) in (7): $t_s = \frac{2n_1}{n_1 + n_2}$ (8)

The transmission coefficient for *p*-polarized light:

$t_p = \frac{2n_1 \cos\theta_i}{n_2 \cos\theta_i + n_1 \cos\theta_t}$ (9)

(3) and (4) in (9): $t_p = \frac{2n_1}{n_2 + n_1}$ (10)

Answer:

reflectance coefficients:

$r_s = \frac{n_1 - n_2}{n_1 + n_2}$ ($r_s = -\frac{n-1}{n+1}$, where $n = \frac{n_2}{n_1}$)

$r_p = \frac{n_2 - n_1}{n_1 + n_2}$ ($r_p = \frac{n-1}{n+1}$, where $n = \frac{n_2}{n_1}$)

transmission coefficient

$t_s = \frac{2n_1}{n_1 + n_2}$ ($t_s = \frac{2}{n+1}$, where $n = \frac{n_2}{n_1}$)

$t_p = \frac{2n_1}{n_2+n_1}$ ($t_p = \frac{2}{n+1}$, where $n = \frac{n_2}{n_1}$)

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