Indian Research Journal
Vol -2 , ISSUE –XI, Dec- 2012
ISSN No-2230 - 7850 Available online at www.lbp.world

ORIGINAL ARTICLE

STUDIES ON TE PLANE WAVE REFLECTION AND REFRACTION

Rakesh Kumar Sharma[1] andDr. KapilDeo Singh[2]
[1]Research Scholar ,Jai Prakash University, Chapra.
[2]Associate Professor, H.O.D., Physics ,R.J.College, Chapra , J.P.University, Chapra.

ABSTRACT:

In case of electromagnetic waves, the familiar phenomena of reflection and fracture occur at the interface between dielectrics. In this chapter we show that the wave houses of electromagnetic waves cause laws for reflectance and refraction on aircraft surfaces, at the same time as their electromagnetic properties lead to Fresnel équations for aircraft-polarized waves with the boundary situations for electric powered and magnet fields at dielectric interfaces.

KEY PHRASES: Electromagnetic Wave, Transverse Magnetic, Transverse Electric, Reflection and Refraction.

INTRODUCTION:

This research is targeted on the mirrored image and transmission of aircraft waves at inter-faces between two distinct optical materials. In this paper we used strength-conservation to study a particular part of this trouble; the phase courting be-tween waves meditated from contrary sides of a dielectric interface. Here we are able to take a look at waves at interfaces in extra element.

What we will locate first is that due to the continuity of aeroplane waves at an interface we can derive the law of mirrored image and the regulation of refraction of Snell! Those legal guidelines shape the inspiration for all of geometrical optics; a highly successful model that even nowadays are utilized in analysis of the most complex imaging and lens design packages.

Evaluation of planes on interface waves also gives us the components for reflecting Fresnel. The reflective and transmission expressions are very beneficial on their own, main to key thoughts of overall-inner reflection, which fashioned the basis of traditional wave steerage, and evanescent fields of unique significance for miniature and incorporated optics.

We will increase the therapy to a couple of interfaces inside the last a part of the segment so that reflection and transmission may be measured through multi-layered structures. This will provide us with the tools to look at fundamental optical additives which include anti-reflection (AR), Bragg Reflectors, leaky wave guides as well as surface plasmons. [1]

In case of electromagnetic waves, the acquainted phenomenon of mirrored image and fracture occur at the interface among dielectrics. On this chapter we demonstrate that the wave residences of the electro-magnetic waves cause the laws of refraction on plane surfaces, at the same time as Fresnel 's equations for plane polarised waves are powered via their electromagnetic residences with the bounds for electro-magnetic fields on the dielectric interfaces. Eventually, we addressed the precise traits connected to waves accidents at an attitude extra than the important perspective[2] on the Brewster angle.

Boundary Conditions: Reflection and Transmission:

Incident wave: $\tilde{f}_I(z,t) = \tilde{A}_I e^{i(k_1 z - \omega t)}$
Reflected wave: $\tilde{f}_R(z,t) = \tilde{A}_R e^{i(-k_1 z - \omega t)}$
Transmitted wave: $\tilde{f}_T(z,t) = \tilde{A}_T e^{i(k_2 z - \omega t)}$

The machine is oscillating at the same frequency oscillating both pieces.
The wave speeds differ in two regimes, meaning that the wave lengths and the wave numbers

$$\frac{v_1}{v_2} = \frac{k_2}{k_1} = \frac{\lambda_1}{\lambda_2}$$
vary

The waves in the two regions:

$$\tilde{f}(z,t) = \begin{cases} \tilde{A}_I e^{i(k_1 z - \omega t)} + \tilde{A}_R e^{i(-k_1 z - \omega t)} & \text{for } z < 0 \\ \tilde{A}_T e^{i(k_2 z - \omega t)} & \text{for } z > 0 \end{cases}$$

Transverse Electromagnetic Wave (the relation between E and B)

$$\nabla \cdot \mathbf{E} = 0 \qquad \frac{\partial E_z}{\partial z} = (\tilde{E}_0)_z ike^{i(kz-\omega t)} = 0 \qquad \Rightarrow (\tilde{E}_0)_z = 0$$
$$\nabla \cdot \mathbf{B} = 0 \qquad \frac{\partial B_z}{\partial z} = (\tilde{B}_0)_z ike^{i(kz-\omega t)} = 0 \qquad \Rightarrow (\tilde{B}_0)_z = 0$$

This implies that electromagnetic waves are transverse: the magnetic and electric fields are perpendicular to their propagation direction. In addition, the law of Faraday

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$
$$\hat{\mathbf{x}}: \quad \frac{\partial (E_0)_z}{\partial y} - \frac{\partial (E_0)_y}{\partial z} = -\frac{\partial (B_0)_x}{\partial t} \quad \Rightarrow \quad k(\tilde{E}_0)_y = -\omega(\tilde{B}_0)_x$$
$$\hat{\mathbf{y}}: \quad \frac{\partial (E_0)_x}{\partial z} - \frac{\partial (E_0)_z}{\partial x} = -\frac{\partial (B_0)_y}{\partial t} \quad \Rightarrow \quad k(\tilde{E}_0)_x = \omega(\tilde{B}_0)_y$$
$$\hat{\mathbf{z}}: \quad \frac{\partial (E_0)_y}{\partial x} - \frac{\partial (E_0)_x}{\partial y} = -\frac{\partial (B_0)_z}{\partial t} \quad \Rightarrow \quad 0 = 0$$

Laws of Reflection and Refraction

The flat wave solutions combined with the electromagnetic field boundary conditions allow us to find reflections and transmissions on a dialectal interface of flat waves. Consider a monochromatic plane wave of the form

$$\vec{E}_i = \vec{E}_{0i} \cdot \exp\left[j\left(\omega_i t - \vec{k}_i \cdot \vec{r}\right)\right] \qquad \text{.........................(1)}$$

Or

$$\vec{E}_i = \vec{E}_{0i} \cdot \cos\left(\omega_i t - \vec{k}_i \cdot \vec{r}\right) \qquad \text{.............................(2)}$$

Dielectric interface incident defined as regular surface. The respective fields are mirrored and transmitted

$$\vec{E}_r = \vec{E}_{0r} \cdot \cos\left(\omega_r t - \vec{k}_r \cdot \vec{r} + \alpha_r\right)$$
$$\vec{E}_t = \vec{E}_{0t} \cdot \cos\left(\omega_t t - \vec{k}_t \cdot \vec{r} + \alpha_t\right) \qquad \text{....................(3)}$$

where αr and αt are phase constants which make it possible for reflexion and transmission-related phase shifts in general. Continuity of the electric field mandates tangential

Continuity of the electric field mandates tangential

$$\vec{S} \times \vec{E}_i + \vec{S} \times \vec{E}_r = \vec{S} \times \vec{E}_t \Rightarrow$$
$$\vec{S} \times E_{0i} \cdot \cos\left(\omega_i t - \vec{k}_i \cdot \vec{r}\right) + \vec{S} \times E_{0r} \cdot \cos\left(\omega_r t - \vec{k}_r \cdot \vec{r} + \alpha_r\right)$$
$$= \vec{S} \times E_{0t} \cdot \cos\left(\omega_t t - \vec{k}_t \cdot \vec{r} + \alpha_t\right) \qquad \text{........................(4)}$$

The equation applies to all dielectric interfaces at all periods and must therefore all argue on the same basis as the harmonic function:

$$\omega_i t - \vec{k}_i \cdot \vec{r}\Big|_{interface} = \omega_r t - \vec{k}_r \cdot \vec{r} + \alpha_r\Big|_{interface}$$
$$= \omega_t t - \vec{k}_t \cdot \vec{r} + \alpha_t\Big|_{interface} \qquad \text{............................(5)}$$

At the frequency of the incident waveωi=ωr=ωt., the three waves undergo forced vibrations, so, i.e: At the interface we have then. [1]

TE mode reflection and refraction at a plane boundary:

We assume, continuously rotate the coordinate system so that the xz plane is the incidence plane. Then the TE modes only contains one y component E and only one y component H is used in the TM mode.

We will define the y component issue of E, Ey, the incident and the fields

$$E_{y1} e^{-i\vec{k}_1 \cdot \vec{r}}, \; E'_{y1} e^{-i\vec{k}'_1 \cdot \vec{r}} \text{ and } E_{y2} e^{-i\vec{k}_2 \cdot \vec{r}}$$

The continuous condition of the tangential E limit simply gives:

$$E_{y1} + E'_{y1} = E_{y2}$$

From

$\nabla \times E = \vec{k}_i \times \vec{E} = -\frac{\partial B}{\partial t} = -i\omega\mu\vec{H}$ ınd that the tangential component of $\vec{H} \times \vec{n}$

we find that(dropping the y subscript):

$$\frac{\left(\vec{k}_1^{'} \times \vec{E}_1\right) \times \vec{n} + \left(\vec{k}_1^{'} \times \vec{E}_1^{'}\right) \times \vec{n}}{\mu_1} = \frac{\left(\vec{k}_2 \times \vec{E}_2\right) \times \vec{n}}{\mu_2}$$

Using the vector identity$(A \times B) \times C = B(CA) - A(C\ B)$and noting that $\vec{n} \bullet \vec{E}_1 = \vec{n} \bullet \vec{E}_1^{'} = \vec{n} \bullet \vec{E}_2 = 0$ ince E is sensitive to the incidence plane

This restriction condition reduces to: and thus perpendicular to n:

$$\frac{\left(\vec{E}_1\left(\vec{n} \bullet \vec{k}_1\right) + \vec{E}_1^{'}\left(\vec{n} \bullet \vec{k}_1^{'}\right)\right)}{\mu_1} = \frac{\vec{E}_2\left(\vec{n} \bullet \vec{k}_2\right)}{\mu_2}$$

Use of the two border equations

$$\vec{E}_1^{'} = \vec{E}_1\left(\frac{\mu_2\left(\vec{n} \bullet \vec{k}_1^{'}\right) - \mu_1\left(\vec{n} \bullet \vec{k}_2\right)}{\mu_2\left(\vec{n} \bullet \vec{k}_1^{'}\right) + \mu_1\left(\vec{n} \bullet \vec{k}_2\right)}\right)$$

And

$$\vec{E}_2 = \vec{E}_1 \frac{\left(\vec{n} \bullet \vec{k}_1\right) 2\mu_2}{\mu_1\left(\vec{n} \bullet \vec{k}_2\right) + \mu_2\left(\vec{n} \bullet \vec{k}_1\right)}$$

These are the vector type Fresnel equations for the reflected and transmitted TE field amplitudes. In light studies, the field transmitted is called the refracted field

CONCLUSION:

It is located, in every case of wave incidence with some exceptions within the essential perspective neighbourhood,that power distribution by using the meditated and transmitted waves complies with strength equations. The coefficients of reflection and transmission primarily based at the material parameters and perspective of occurrence have been located

.

REFERENCES:

1. Solgaard O. (2009) Plane Waves at Interfaces. In: Photonic Microsystems. MEMS Reference Shelf. Springer, Boston, MA. https://doi.org/10.1007/978-0-387-68351-5_3

2. Dobbs E.R. (1993) Reflection and refraction. In: Basic Electromagnetism. Physics and Its Applications. Springer, Dordrecht. https://doi.org/10.1007/978-94-011-2112-5_11
3. A. G. Gurevich, *Ferrites at Microwave Frequencies* (Boston Technical Publishers, Inc., Cambridge, Massachusetts, 1965), Chap. VII, pp. 147–171. **Google Scholar**
4. G. R. Fowles, *Introduction to Modern Optics* (Holt, Reinhart, and Winston, New York, 1968), Chap. 5, pp. 168–182. **Google Scholar**
5. Every A., Neiman V.: Reflection of electroacoustic waves in piezoelectric solids: mode conversion into four bulk waves. J. Appl. Phys. **71**, 6018–6024 (1991)
6. Burkov, S.I., Sorokin, B.P., Karpovich, A.A., Aleksandrov, K.S.: Reflection and refraction of bulk acoustic waves in piezoelectric crystals under the action of bias electric field and uniaxial pressure. In: Ultrasonics Symposium, 2008 IEEE, pp. 2161–2164 (2008)