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BREWSTER-LIKE REFLECTIONLESS TRANSMISSION OF EVANESCENT WAVES THROUGH A PLANE TWO-MEDIA INTERFACE

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Abstract

We propose a Brewster-like reflectionless transmission effect of evanescent waves: no evanescent reflected waves are observed at evanescent wave incidence on a plane interface of two media. Similar to the well-known Brewster effect for propagating waves, the proposed Brewster-like effect for evanescent waves occurs when surface impedances of waves in the neighboring media are equal. Contrary to the known Brewster effect for complex incidence angles related to the existence of some surface wave (when surface impedances are equal for evanescent waves to both sides of the two-media interface decaying in the directions away from the interface), the proposed Brewster-like reflectionless transmission corresponds to the surface impedances equality for evanescent waves decaying in the same direction. It was shown that the proposed Brewster-like effect for evanescent waves can occur for both (p- and s-) polarizations and only for magnetic media ($\mu \neq 1$ for at least one of the two neighboring media). Based on the proposed Brewster-like reflectionless transmission of evanescent waves, we suggest a method of a totally-reflected-wave's phase patterning with a pattern vanishing exactly at Brewster's angle.

Keywords: Brewster effect, evanescent wave, near field, magnetodielectric, surface wave

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1. Introduction

The famous Brewster effect has been known for more than two centuries in optics of dielectric media [1]. This effect is one of the basic ones in polarization optics and it has numerous applications, e.g., in polarizers, glare filters, gas lasers, for broadband angular selectivity, for avoiding unwanted light reflection in holography and microscopy [2–7].

Due to the rapid development of electrodynamics of metamaterials (including optics of metamaterials with non-unit magnetic permeability [8–11]) in the last years, the Brewster effect has been intensively studied for magnetodielectric media interfaces [12–19]. For example, the Brewster effect was predicted for s-polarized waves on an interface of two magnetodielectric media with positive refractive indices [12, 13, 19], for either s- or p-polarized waves on an interface of media with positive and negative refractive indices [18]. In addition, it was shown that under some conditions the Brewster angle at a two-media interface is absent for both polarizations [15] or under some other conditions it exists simultaneously for both polarizations [15].

The extension of many effects formerly known for propagating waves to the case of evanescent optical waves (near field) has been one of the important trends in modern optics (nanooptics) in the last two decades. Thus, a near-field optical microscope [20], near-field optical tweezers [21], near-field molecular spectroscopy [22, 23], and near-field holography [24] have been developed. In the current article, we consider transmission of evanescent waves through systems of magnetodielectric layers and, in particular, analyze an analog of the Brewster effect for evanescent waves when no evanescent reflected waves are observed at evanescent wave incidence on a plane interface between two media (below we will refer to this effect as the Brewster-like reflectionless transmission of evanescent waves).

First, we recollect features of the Brewster effect for propagating waves in magnetodielectric layers. Then, we analyze if a Brewster-like reflectionless transmission of evanescent waves exists. Finally, we consider

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a possible application of the Brewster-like reflectionless transmission of evanescent waves.

2. Theory. Description of the Brewster effect for propagating waves in terms of surface impedances

First, let us recollect features of the Brewster effect for propagating waves. The well-known Brewster effect on an interface of two dielectrics proves itself as zero reflection of a p-polarized propagating plane wave incident on this interface at a certain angle (Brewster's angle). Similarly, the variations of the Brewster effect at interfaces of magnetodielectric media (either for p- or for s-polarization) studied in [13–15, 18] show themselves in zero reflection of propagating plane waves incident on these interfaces at certain angles. This zero reflection, corresponding to Brewster's angle, meets the equality condition of surface impedances Z of waves in neighboring magnetodielectrics (read [25] on surface impedance). Indeed, let us consider a plane interface of two half-spaces filled with magnetodielectrics with permittivity and permeability ε_1 and μ_1 and with ε_2 and μ_2 (see Fig. 1).

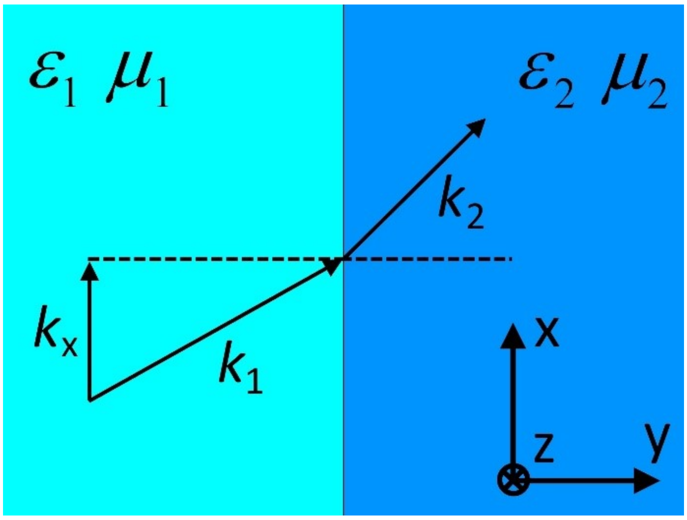

Fig. 1 – Transmittance of a plane wave through an interface between magnetodielectric with dielectric permittivity ε_1 and magnetic permeability μ_1 and magnetodielectric with ε_2 and μ_2.

By definition, surface impedance Z of a plane wave incident on a plane surface is the proportionality coefficient between the electric field component $\boldsymbol{E}_t$ tangent to this surface and the tangent component $\boldsymbol{H}_t$ of the magnetic field of this wave:

$$\boldsymbol{E}_t = Z\left[\boldsymbol{H}_t \times \boldsymbol{n}\right], \tag{1}$$

where $\boldsymbol{n}$ is a normal vector to the surface [25]. Thus, surface impedance is a value determined both by the plane wave and by the surface considered. Surface impedance characterizes a single (with definite wave vector $\boldsymbol{k}$ and definite polarization s- or p-) wave incident on a plane surface. Note that Z of a reflected wave has the opposite sign compared to Z of the incident wave because $\boldsymbol{H}_t$ changes its sign on reflection concerning the xz-plane whereas $\boldsymbol{E}_t$ remains unchanged. The Maxwell's boundary conditions are known to require the continuity of electric and magnetic field tangent components at a media interface. Therefore, the equality of the surface impedance of a wave in one medium to the surface impedance of a wave in another – neighboring – medium means that only one wave (either incident or transmitted) in each medium is needed to meet the boundary conditions on the media's common interface. In other words, when the surface impedance of a wave incident on an interface from one medium equals to the surface impedance of the transmitted wave in another medium to the other side of the interface, the reflected wave is absent.

Let us consider the cases of p- and s-polarized waves in more details and derive expressions for surface impedances in magnetodielectric medium. We consider a plane wave with the wave vector $\boldsymbol{k}_1$ incident on a plane interface parallel to the coordinate plane xz (see Fig. 1). The plane of incidence is parallel to the coordinate plane xy and the tangent component of the wave vector equals to k_x (this component remains the same for waves in both sides from the interface). First, let us consider p-polarized waves with magnetic fields parallel to the z-axis. The z-component of the magnetic field is $H_z = A_z \exp\left(ik_{1y}y + ik_x x\right)$ (here and further we omit the factor $\exp(-i\omega t)$), where $k_{1y} = \sqrt{k_0^2\varepsilon_1\mu_1 - k_x^2}$ is the y-component of the wave vector $\boldsymbol{k}_1$ in the first medium, A_z is the magnetic field amplitude and k_0 is the wave number in vacuum. From the Maxwell equations, $E_x = -(\partial H_z/\partial y)/ik_0\varepsilon_1 = -k_{1y}H_z/k_0\varepsilon_1$. Therefore, the surface impedance of the wave in the first medium with ε_1 and μ_1 is

$$Z_{1p} \equiv \frac{E_x}{[\boldsymbol{H} \times \boldsymbol{e}_y]_x} = -\frac{E_x}{H_z} = \frac{k_{1y}}{k_0\varepsilon_1} = \frac{\sqrt{k_0^2\varepsilon_1\mu_1 - k_x^2}}{k_0\varepsilon_1}. \tag{2}$$

The surface impedances equality condition

$$\sqrt{k_0^2\varepsilon_1\mu_1 - k_x^2}\Big/k_0\varepsilon_1 \equiv Z_{1p} = Z_{2p} \equiv \sqrt{k_0^2\varepsilon_2\mu_2 - k_x^2}\Big/k_0\varepsilon_2 \tag{3}$$

gives

$$(k_x/k_0)_p^2 = \varepsilon_1\varepsilon_2\left(\varepsilon_1\mu_2 - \varepsilon_2\mu_1\right)/\left(\varepsilon_1^2 - \varepsilon_2^2\right). \tag{4}$$

In the case of nonmagnetic media, this condition has the form of $(k_x/k_0)^2 = \varepsilon_1\varepsilon_2/(\varepsilon_1+\varepsilon_2)$ and transforms into the well-known formula $\tan\alpha_1 \equiv (k_x/k_0)\Big/\sqrt{\varepsilon_1 - (k_x/k_0)^2} = \sqrt{\varepsilon_2/\varepsilon_1}$, where α_1 is the incidence angle of a wave in the medium with dielectric permittivity ε_1.

By analogy, we consider an s-polarized wave. The electric field is directed along the z-axis and equals to $E_z = A_z\exp\left(ik_{1y}y + ik_xx\right)$, where A_z is the electric field amplitude. From the Maxwell equations, $H_x = (\partial E_z/\partial y)/ik_0\mu_1 = k_{1y}E_z/k_0\mu_1$. Therefore, the surface impedance of the wave in the medium with ε_1 and μ_1 is

$$Z_{1s} \equiv \frac{E_z}{[\boldsymbol{H}_x \times \boldsymbol{e}_y]_z} = \frac{E_z}{H_x} = \frac{k_0\mu_1}{k_{1y}} = \frac{k_0\mu_1}{\sqrt{k_0^2\varepsilon_1\mu_1 - k_x^2}}, \tag{5}$$

and the surface impedances equality condition $Z_{1s} = Z_{2s}$ gives the formula for Brewster's angle

$$(k_x/k_0)_s^2 = \mu_1\mu_2\left(\varepsilon_2\mu_1 - \varepsilon_1\mu_2\right)/\left(\mu_1^2 - \mu_2^2\right). \tag{6}$$

Even though the Brewster effect in magnetodielectric media was described and studied more than forty years ago [19], the case when there are only waves evanescent in the y-direction in neighboring layers (i.e. the "complex incidence angle" case when $k_x^2 > k_0^2\varepsilon_1\mu_1$ and $k_x^2 > k_0^2\varepsilon_2\mu_2$) has been analyzed incompletely. In particular, the case of surface impedances equality for evanescent waves decaying in the same direction (e.g. in the $+y$-direction) in two neighboring media has not been considered yet. On the contrary, the case of surface impedances equality for evanescent waves to both sides of the two-media interface decaying in the directions away from the interface is well-studied and is commonly related to as the Brewster condition at complex incidence angles [26]. The last case corresponds to a surface wave running along the two-media interface (e.g. surface plasmon-polariton, Zenneck wave etc.) [26, 27].

In the present paper, we carefully analyze the case of an evanescent wave incidence on a two magnetodielectric media interface and find out whether a kind of a Brewster-like reflectionless transmission exists in this case of evanescent waves.

3. Results. The Brewster effect for evanescent waves

Let us consider a medium with ε_1 and μ_1 (we consider only real-valued dielectric permittivities and magnetic permeabilities in this paper). Let a p-polarized plane wave evanescent in the y-direction with $k_x^2 > k_0^2\varepsilon_1\mu_1$ propagate in this medium. In this case, magnetic field $H_z = A_z\exp\left(-\kappa_{1y}y + ik_xx\right)$ and the x-component of the electric field $E_x = -(\partial H_z/\partial y)/ik_0\varepsilon_1 = \kappa_{1y}H_z/ik_0\varepsilon_1 \equiv -Z_{1p}H_z$, where $\kappa_{1y} = \sqrt{k_x^2 - k_0^2\varepsilon_1\mu_1} > 0$ and

$$Z_{1p} = -\kappa_{1y}/ik_0\varepsilon_1 = -\sqrt{k_x^2 - k_0^2\varepsilon_1\mu_1}\Big/ik_0\varepsilon_1. \tag{7}$$

By analogy, for an evanescent wave decaying in the y-direction with $k_x^2 > k_0^2\varepsilon_2\mu_2$ in the medium with ε_2 and μ_2 $H_z = \tilde{A}_z\exp\left(-\kappa_{2y}y + ik_xx\right)$, and $E_x \equiv -Z_{2p}H_z = \kappa_{2y}H_z/ik_0\varepsilon_2$, where $\kappa_{2y} = \sqrt{k_x^2 - k_0^2\varepsilon_2\mu_2} > 0$ and $\tilde{A}_z$ is the magnetic field amplitude in the second medium. Therefore, in the case of $Z_{1p} = Z_{2p}$, it can be possible that only one above-mentioned evanescent wave decaying in the y-direction exists in each medium (see Fig. 2) and Maxwell's boundary conditions at the media interface are met.

Let us analyze in details the condition $Z_{1p} = Z_{2p}$ under the assumptions $\varepsilon_1,\varepsilon_2,\mu_1,\mu_2 \neq 0$, $k_x^2 > k_0^2\varepsilon_1\mu_1$, $k_x^2 > k_0^2\varepsilon_2\mu_2$, $\kappa_{1y} > 0$ and $\kappa_{2y} > 0$. From this condition we obtain $\varepsilon_1\varepsilon_2 > 0$ (contrary to the surface plasmon-polariton existence condition when $\kappa_{1y} = -\sqrt{k_x^2 - k_0^2\varepsilon_1\mu_1} < 0$ and $\varepsilon_1\varepsilon_2 < 0$). The Brewster condition $Z_{1p} = Z_{2p}$ in this case is

$$(k_x/k_0)_p^2 = \varepsilon_1\varepsilon_2\left(\varepsilon_1\mu_2 - \varepsilon_2\mu_1\right)/\left(\varepsilon_1^2 - \varepsilon_2^2\right) > 0 \tag{8}$$

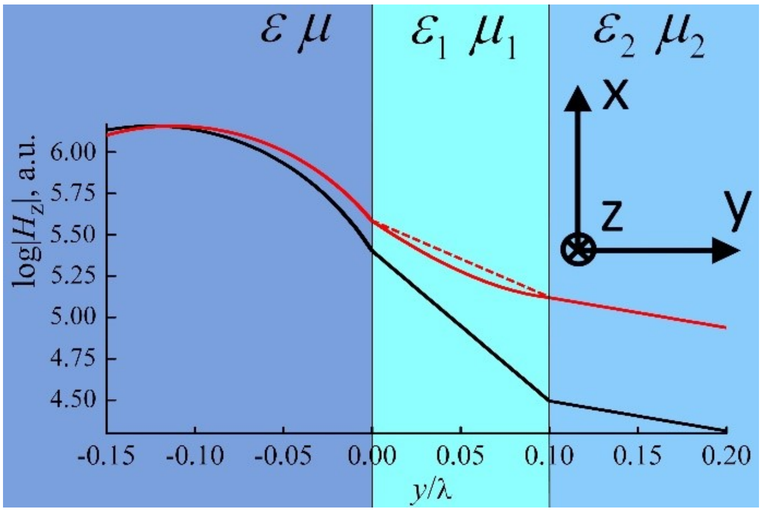

Fig. 2 – Dependencies of magnetic field z-component magnitude (in logarithmic scale) on the y-coordinate in the case of a p-polarized plane wave with $k_x = k_0\sqrt{85/12}$ incident in the xy-plane from the left. The black curve corresponds to the case of $\varepsilon_2 = 1.0$ and $\mu_2 = 7.0$, the solid red curve – to the case of $\varepsilon_2 = 7.0$ and $\mu_2 = 1.0$. In both cases, $\varepsilon = 9.0$, $\mu = 1.0$, $\varepsilon_1 = 5.0$ and $\mu_1 = 1.0$. At $y < 0$ there is the medium with ε and μ, at $0 < y < 0.1\lambda$ the layer with ε_1 and μ_1 is placed, and at $y > 0.1\lambda$ there is the half-space with ε_2 and μ_2. The dashed red line is a straight-line segment connecting points of the solid red curve

and is the same as given above (4) for non-evanescent waves. Then, assuming $\varepsilon_1^2 > \varepsilon_2^2$ without loss of generality, we have $\varepsilon_1\mu_2 > \varepsilon_2\mu_1$. In turn, from the conditions $(k_x/k_0)^2 > \varepsilon_1\mu_1$ and $(k_x/k_0)^2 > \varepsilon_2\mu_2$ we have $\varepsilon_2\mu_2 > \varepsilon_1\mu_1$ (both for $0 < \varepsilon_2 < \varepsilon_1$ and for $\varepsilon_1 < \varepsilon_2 < 0$). These conditions

$$\varepsilon_1\varepsilon_2 > 0,\quad \varepsilon_1^2 > \varepsilon_2^2,\quad \varepsilon_1\mu_2 > \varepsilon_2\mu_1\ \ \textit{and}\ \ \varepsilon_2\mu_2 > \varepsilon_1\mu_1 \tag{9}$$

However, they require $\mu_2 \neq \mu_1$. Therefore, the Brewster-like reflectionless transmission for evanescent p-polarized waves cannot be realized for nonmagnetic media.

By analogy, we consider the case of s-polarized waves evanescently decaying in the y-direction with $k_x^2 > k_0^2\varepsilon_1\mu_1$ and $k_x^2 > k_0^2\varepsilon_2\mu_2$. In the first medium the electric field is $E_z = A_z \exp(-\kappa_{1y}y + ik_x x)$ and the x-component of the magnetic field is $H_x \equiv E_z/Z_{1s} = -\kappa_{1y}E_z/ik_0\mu_1$, where

$$Z_{1s} = -ik_0\mu_1/\kappa_{1y} = -ik_0\mu_1 \Big/ \sqrt{k_x^2 - k_0^2\varepsilon_1\mu_1}. \tag{10}$$

It follows from the surface impedances equality condition $-ik_0\mu_1/\kappa_{1y} \equiv Z_{1s} = Z_{2s} \equiv -ik_0\mu_2/\kappa_{2y}$ and with $\kappa_{1y} > 0$ and $\kappa_{2y} > 0$ that $\mu_1\mu_2 > 0$ and the Brewster condition $Z_{1s} = Z_{2s}$ is

$$(k_x/k_0)_s^2 = \mu_1\mu_2\,(\varepsilon_2\mu_1 - \varepsilon_1\mu_2)\big/\big(\mu_1^2 - \mu_2^2\big) > 0, \tag{11}$$

having the same view as for the case of non-evanescent s-polarized waves (6). Therefore, for the last inequality along with conditions $k_x^2 > k_0^2\varepsilon_1\mu_1$ and $k_x^2 > k_0^2\varepsilon_2\mu_2$ to be compatible, the following conditions must be satisfied (without loss of generality):

$$\mu_1\mu_2 > 0,\quad \varepsilon_1\mu_1 > \varepsilon_2\mu_2\ \ \textit{and}\ \ \varepsilon_1\mu_2 > \varepsilon_2\mu_1\ \ \textit{at}\ \ \mu_2^2 > \mu_1^2. \tag{12}$$

Obviously, these inequalities require $\varepsilon_2 \neq \varepsilon_1$. As in the case of p-polarized evanescent waves, the Brewster-like reflectionless transmission for s-polarized evanescent waves does not occur in nonmagnetic media.

By a particular example let us illustrate the fact that a reflected evanescent wave is absent in the case of equal surface impedances. We consider a layer of the thickness $d = 0.1\lambda$ with $\varepsilon_1 = 5.0$ and $\mu_1 = 1.0$ between a half-space with $\varepsilon_2 = 1.0$ and $\mu_2 = 7.0$ (to the right of the layer) and a half-space with $\varepsilon = 9.0$ and $\mu = 1.0$ (to the left of the layer) (see Fig. 2). The specified values of ε_1,ε_2,μ_1,μ_2 meet the conditions (9) when the Brewster-like reflectionless transmission for p-polarized evanescent waves can occur. Let a p-polarized wave with the x-component of the wave vector k_x be incident from the left half-space. The Brewster-like reflectionless transmission through the interface between the layer with ε_1 and μ_1 and the right half-space with ε_2 and μ_2 is realized at $(k_x/k_0)_p^2 = \varepsilon_1\varepsilon_2\,(\varepsilon_1\mu_2 - \varepsilon_2\mu_1)\big/\big(\varepsilon_1^2 - \varepsilon_2^2\big) = 85/12$ (Eq. 4). In this case, $(k_x/k_0)_p^2 > \varepsilon_1\mu_1 = 5$,

$(k_x/k_0)_p^2 > \varepsilon_2\mu_2 = 7$ and $(k_x/k_0)_p^2 < \varepsilon\mu = 9$. As shown in Fig. 2 (black curve), under the condition of $(k_x/k_0)_p^2 = 85/12$, only one evanescent wave (decaying in the y-direction) exists in the layer. On the contrary, if $\varepsilon_2 = 7.0$ and $\mu_2 = 1.0$, the Brewster condition is not met at $(k_x/k_0)^2 = 85/12$, and the field in the layer is a sum of two evanescent waves, one of which decays in the y-direction and the other grows (see the solid red line in Fig. 2 which is not a straight-line segment in the layer).

Thus, the proposed Brewster-like effect manifests itself in the absence of a reflected evanescent wave. On the other hand, contrary to the Brewster effect for propagating waves, the power reflection coefficient is a unity in some range of values of k_x around Brewster's angle because of total internal reflection.

4. Discussion. Reflected wave phase tailoring

One of the actively developing areas of modern electromagnetics is electrodynamics of metasurfaces – surfaces structured on a subwavelength scale in a certain way. One of the applications of metasurfaces is manipulating the phase and amplitude of reflected waves along a metasurface plane [28, 29]. The described Brewster-like reflectionless transmission of evanescent waves enables manipulating the phase of a wave totally reflected from a layered surface depending on the thicknesses of layers. In this case, the reflected wave phase may depend on the layers' thicknesses only at incidence angles that do not meet the Brewster condition ((4) or (6)) whereas the phase of the reflected wave is independent of the layers' thicknesses if the incident wave satisfies the Brewster condition.

To illustrate this effect, let us consider a plane magnetodielectric layer between two half-spaces of magnetodielectrics (see Fig. 3) again. Let a p-polarized plane wave with x-component k_x of the wave vector be incident from the left half-space.

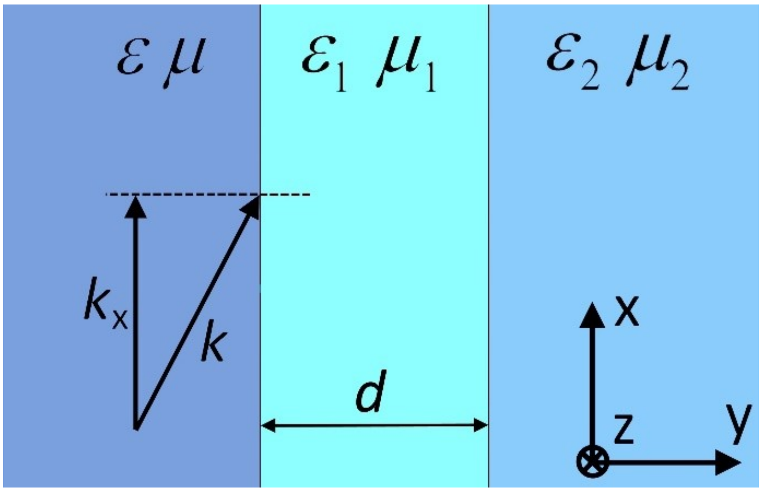

Fig. 3 – The structure demonstrating manipulation of a reflected wave phase. A plane wave with x-component k_x of the wave vector is incident from the left half-space with ε and μ on a layer with ε_1 and μ_1

If the Brewster condition (4) is met at the interface of the layer and the right half-space, a reflected evanescent wave (growing in the y-direction) is absent in the layer. Therefore, the characteristics of the wave reflected in the left half-space is independent of the layer thickness. Indeed, this can be seen in Fig. 4, where the phase of the reflectance r in the left half-space is shown as a function of k_x/k_0 for different layer thicknesses d and for $\varepsilon_2 = 1.0$ and $\mu_2 = 7.0$ (the r magnitude equals to 1 at the Brewster condition because $(k_x/k_0)_p^2 > \varepsilon_2\mu_2$). However, if the Brewster condition (4) is not met there is a reflected evanescent wave in the layer growing in the y-direction, which leads to the dependence of r phase on d.

Based on this effect of reflectance phase independence on d at the Brewster condition (4) and reflectance phase dependence on d for other incidence angles, we could tailor the reflected field phase distribution along the reflecting surface (by setting the distribution of d along the surface while the interface between the medium with ε and μ and the medium with ε_1 and μ_1 remains plane) so that this distribution depends on the incidence angle k_x/k_0. At Brewster's incidence angle, the reflectance from the surface has a uniform phase distribution.

5. Conclusions

In the paper we proposed the Brewster-like reflectionless transmission of evanescent waves through a two-media interface. If an evanescent wave is incident on a plane interface between two media (in the case

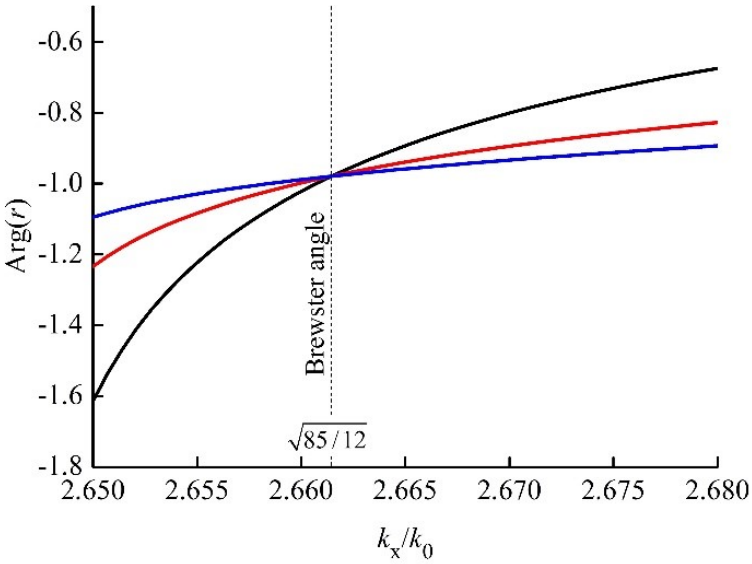

Fig. 4 – Phase of the reflectance r in the left half-space (see Fig. 2 or Fig. 3) as functions of k_x/k_0. The black curve corresponds to the layer thickness $d = 0$, the red curve – $d = 0.05\lambda$, the blue curve – $d = 0.1\lambda$

of incident wave decaying along the normal to the interface in the direction to the interface), the reflected evanescent wave, decaying in the direction opposite to that of the incident wave, may be absent. Similar to the known Brewster effect for propagating waves, the proposed Brewster-like effect for evanescent waves occurs when surface impedances of waves in the neighboring media are equal. Contrary to the known Brewster effect for complex incidence angles related to existence of some surface wave (when surface impedances are equal for evanescent waves to both sides of the two-media interface decaying in the directions away from the interface), the proposed Brewster-like reflectionless transmission corresponds to the surface impedances equality for evanescent waves decaying in the same direction.

We considered both the cases of p- and s-polarized waves. It was shown that the Brewster-like reflectionless transmission for evanescent waves could occur for any of these polarizations. In the case of each of these polarizations, it is necessary that at least one of the two neighboring media has magnetic properties (i.e. has magnetic permeability different from unity) for the reflectionless transmission to take place.

Based on the Brewster-like reflectionless transmission effect for evanescent waves, we proposed a method of tailoring of totally-reflected-wave phase distribution in the plane of a reflecting surface. If we take such system of plane layers as a reflecting system, that the Brewster condition for evanescent waves is met at the interfaces between these layers, the reflected wave phase will be independent of the number and the thicknesses of these layers at the Brewster condition. However, at other angles the reflected wave's phase will depend on the characteristics of this layered system. This fact could be used for the development of a structured layered system with layers' thicknesses varying along the layers plane, thus, providing a desired totally-reflected-wave phase distribution. This distribution would be observed only for incidence angles different from Brewster's angle, whereas the phase distribution would be uniform at Brewster's angle.

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БЕЗОТРАЖАТЕЛЬНОЕ ПРОХОЖДЕНИЕ (ЭФФЕКТ БРЮСТЕРА) ЭВАНЕСЦЕНТНЫХ ВОЛН ЧЕРЕЗ ПЛОСКУЮ ГРАНИЦУ ДВУХ СРЕД

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Аннотация

Мы описываем и теоретически анализируем эффект безотражательного прохождения эванесцентных волн через границу сред, подобный эффекту Брюстера для распространяющихся волн. Данный эффект выражается в том, что если на плоскую границу раздела двух сред падает эванесцентная волна (когда падающая волна затухает в направлении по нормали к границе раздела двух сред), то отраженная эванесцентная волна, затухающая в направлении, противоположном направлению затухания падающей волны, отсутствует. Назовем данный эффект безотражательным прохождением Брюстера для эванесцентных волн. Подобно известному эффекту Брюстера для распространяющихся волн, безотражательное прохождение Брюстера для эванесцентных волн возникает, когда поверхностные импедансы волн в граничащих средах равны. Известный эффект Брюстера для комплексного угла падения связан с существованием поверхностной волны, когда поверхностные импедансы равны для эванесцентных волн по обе стороны границы, затухающих в направлениях от границы двух сред. При этом описываемое нами безотражательное прохождение Брюстера соответствует равенству поверхностных импедансов для эванесцентных волн, затухающих в одном и том же направлении. Для плоских границ двух сред было теоретически показано, что эффект Брюстера для эванесцентных волн может иметь место как для p-, так и для s- поляризации, причем только если хотя бы одна из двух граничащих сред обладает магнитными свойствами ($\mu \neq 1$). На основе рассмотренного эффекта безотражательного прохождения Брюстера предложен метод настройки фазового распределения волны, испытавшей полное отражение, в плоскости отражающей поверхности, притом что данное фазовое распределение превращается в однородное при условии безотражательного прохождения Брюстера.

Ключевые слова: эффект Брюстера, эванесцентная волна, ближнее поле, магнитодиэлектрик, поверхностная волна
