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Research Paper

Study of Polarization Type on Reflectivity For Multilayer Surfaces

Science

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Haider Y. Hammod	Ministry of Science and Technology
Noor L .Hussain	Ministry of Science and Technology

ABSTRACT

In this research ,a theoretical study to design different reflection mirrors depending on incident angle and polarization type . which used as output coupler for laser resonator have been established the (open filter)program and multi layers coating on BK7substrate produce have been used for this purpose . From result s the (maximum reflectivity was 93.59%wheneθ=(600) for mirror with (five layers) for(InSb+InAs) for (s-) polarization type. While the reflectivity become(38.87%)for θ=(600) with same number of layers for(p-) polarization type.

1-Theortical concepts :-

Oblique incident will now be considered. For any direction of the vector amplitude of the incident wave , it is evident that the application of the boundary conditions leads to complicated and difficult expressions for the vector amplitudes of the reflected and transmitted waves. The oblique incident calculations are simpler if the wave is split into two plan- polarized components, one with the electric vector in the plan of incidence ,known as p-polarized (or TM ,for transverse magnetic field) and one with the electric vector normal to the plan of incidence, known as S- polarized (or TE, for transverse electric field).The propagation of each of these waves can be treated completely independently of each other ,Calculation are further simplified if only energy flows normal to the boundaries and electric and magnetic fields parallel to the boundaries are considered, as this is formulation is equivalent to a homogenous wave .Again the boundary condition can be applied . Since the phase factors have already been accounted for , only the vector amplitudes will be considered[1,2].

$$\begin{pmatrix} E_a \\ H_a \end{pmatrix} = \begin{bmatrix} cos^{\delta} & isin^{\delta}/^{\eta} \\ i^{\eta}{}_{sin^{\delta}} & cos^{\delta} \end{bmatrix} \begin{pmatrix} E_b \\ H_b \end{pmatrix} \dots\dots\dots\dots\dots (1)$$

When $\delta = 2\pi\, nd \cos\theta / \lambda$ ....(2)

Now, tilted optical admittance, η , can be defined as[3] :

$\eta_s = n \cos\theta$ (for s – waves) .. ...(3)

$\eta_p = n/\cos\theta$ (for p – waves) .....(4)

Where(n) reflective index,(d)thickness,(λ)wave length

$$R = \left(\frac{\eta_0 B - C}{\eta_0 B + C}\right)\left(\frac{\eta_0 B - C}{\eta_0 B + C}\right)^* \dots\dots\dots\dots\dots (5)$$

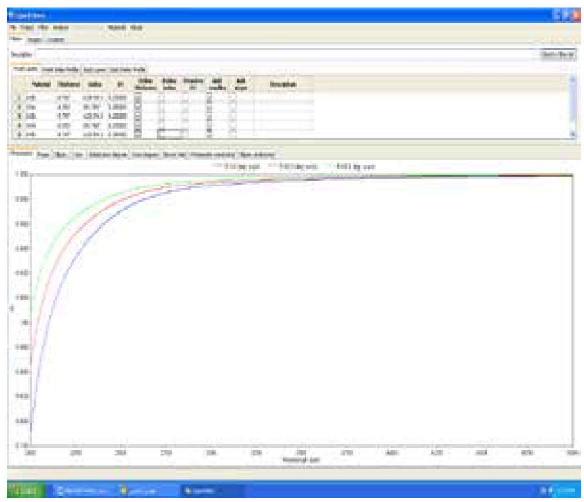
$$T = \frac{4\eta_0 \mathrm{Re}(\eta sub)}{(\eta_0 B + C)(\eta_0 B + C)^*} \dots\dots\dots\dots\dots (6)$$

And if

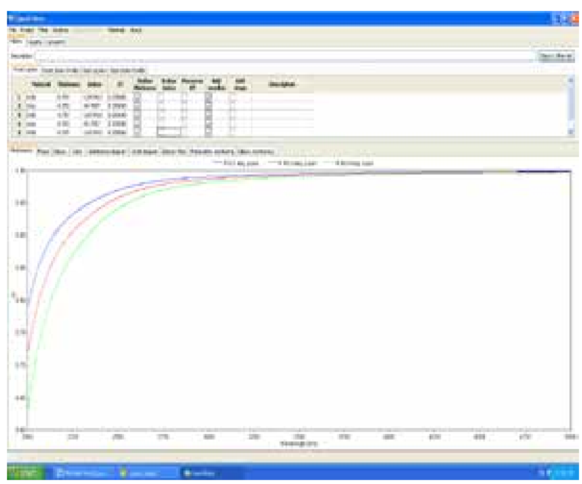
These expression can be used to compute the variation of reflectance of simple boundaries between extended media and then examined as a function of angle of incidence .In the case where there is no absorption in the material with 1, it can be seen that the reflectance for p- polarized light(TM) falls to zero at a definite angle . This particular angle is known as the Brewster angle and is of some importance[4].

2- Results and Discussion:-

The basic structure is a multi-layer stack of alternately high index and low index thin films, with thickness one-quarter at the design wave length. we used the two two material (InSb) and (InAs) as high and low index materials respectively deposited on BK7 substrate .reflectivity when we calculated the reflectively as a function of wave length we obtain the figure(1) .And used oblique angle for wave length (2000-5000) .



Figure(1)phase change on reflection for polarize (s-)



Figure(2)phase change on reflection for polarize (p-)

Table(1): Variation of angle of incidence for reflection polarization

θ	Reflectivity s-	Reflectivity p-
0^0	99.10	99.1
45^0	99.36	98.74
60^0	99.55	98.22

The two figures indicate that for oblique incidence the bandwidth for p-polarization is always narrower than that for s-polarization. This difference in bandwidth is a consequence of the fact that TE and TM waves have different band structures and therefor different reflectivity's. Figure(1) reveals the characteristics Of the "high-reflectance zone " whilst Fig(2) shows the characteristics of the phase change on reflection as the angle of incidence is varied from 0^0 to $45^0$to 60^0. For oblique angles of incidence there is a polarization splitting and the reflectance curves shift toward shorter wave length with increasing angles on incidence. There is an increasing in reflectivity for s-polarization and an overall decrease in reflectivity for p- polarization .Hence , for oblique incidence, maximum band width and reflectivity can be achieved through s- polarization (TEpolarization)

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