THE MICROWAVE POLYMER ABSORBENTS

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The technique of the layer thickness selection and composition of the binary absorbent microwave coverings are presented in the paper.

INTRODUCTION

The essentiality of the papers, connected with the theoretical analysis of the appearing condition of the non-reflecting absorption of the electromagnetic radiation in the layer of the polar dielectric, taking into consideration its characteristics, treatment of the methodological and algorithmic software with the treatment of the methods of the measurements of the strongly-absorbent materials in the high-frequency range, based on the non-reflecting wave absorption effect, makes them very perspective.

The existence the non-reflecting wave absorption effect in the polar liquids and their solutions in the non-polar absorbents makes the perspective of their using in the capacity of the non-reflecting absorbents of high-frequency radiation. Such coverings may be used in the location techniques in the action band of the radio transmitting devices, at the creation of the dead rooms, and in the other areas of techniques and ecology, where appears the necessity in the absorption of the electromagnetic radiation of the given frequency, also. The existing absorbents of the electromagnetic radiation are carried out, as a rule, on the base of the compositional materials and have in their composition the thin metallic wires or high-disperse metallic particles. Moreover, the dissipation of the electromagnetic radiation takes place in the surface layer because of skin-effect [1,2,3].However, in such absorbents the effective dissipation of the electromagnetic radiation decreases with the increase of its frequency, and that makes difficultness of the creating the high-frequency absorbents of electromagnetic radiation on the base of existing conducting materials.

In such cases, when absorbents of the electromagnetic radiation have the metallic base, covered by dielectric film on it, in the capacity of which the polar substance with the maximal dispersion near given range of wavelength was used, it is hardly to select the material of the absorbing film, the dielectric properties of which satisfy to the conditions of the non-reflecting absorption of the incident electromagnetic radiation of the given frequency.

In this direction prefer in the capacity of the material of the absorbing covering to use the homogeneous mixture, consisting on the polar dielectric with dispersion near the given range of wavelength and non-absorbing radiation of the non-polar substance, but not the concentration of the polar component of the mixture, and thickness of the covering layer it is need to choose from the theoretical positions, concluded for the case of the absence of the reflection of the electromagnetic radiation of the given frequency from dielectric-metal system.

THE MAIN CONTENT

It is known, that at the presence of the absorption of the electromagnetic radiation in the dielectric layer, covered on the metallic base, the dependence of the amplitude of the reflected wave on the thickness l of the covering layer has oscillating and damped character. The state and value of the module of the wave *R* reflection coefficient in the external points of this dependence is defined by the dielectric parameters of the covering substance and radiation frequency f .Moreover, the non-reflecting wave absorption in the considered two-layered system dielectric-metal realizes in the minimum points of the dependence *R* on l at the carrying of the following conditions

$$\left(1+y^2\right)\cdot\lambda/\lambda_g = th\left(2\pi l_0 y/\lambda_g\right) - y\cdot tg\left(2\pi l_0/\lambda_g\right)$$
$$y\cdot sh\left(4\pi l_0 y/\lambda_g\right) + \sin\left(4\pi l_0/\lambda_g\right) = 0 \qquad (1)$$

where

$$y = tg\,\delta/2\,,\ \delta = arctg\,{}^{\varepsilon''}\!/_{\varepsilon'}\,,\ \varepsilon',\varepsilon''$$

is the dielectric constant and dielectric loss of covering substance, correspondingly; λ , λ_g are wavelength in the vacuum and dielectric, correspondingly, l_0 is the thickness of covering layer, at which *R* becomes equal to 0).

So

$$\varepsilon' = \left(1-y^2\right)\cdot\left(\frac{\lambda}{\lambda_g}\right)^2;\quad \varepsilon'' = 2y\cdot\left(\frac{\lambda}{\lambda_g}\right)^2; \qquad (2)$$

the joint decision of the equations (1), (2) is defined the functional connection between λ , l_0 , ε' and ε"of material of the absorbing film, corresponding to the case of the complete extinction of radiation in the covering layer by the way of the deletion from the equations of λ and y .

The results of calculations by the equations (1), (2) are presented graphically in the axis of ordinates *[ε', ε"]* (fig.1). They are equal to the first three minimums of curve *R* on l , under the condition, that in the chosen its points of extremum points the wave reflection is absent. Every point of these dependencies is equal to definite value of the given thickness l_0/λ of covering layer, at which the conditions of non-reflecting wave absorption are carrying out.

If absorbent's covering is formed in the type of binary mixture of absorbent and nonabsorbent material, so values of the concentration dependencies ε″ and ε′of mixture at the chosen radiation frequency are necessary for the finding of

the resonance composition of mixture φ and thickness l of the layer.

In this case it is necessary to cover the found dependence of ε′′and ε′ in the fig.1.

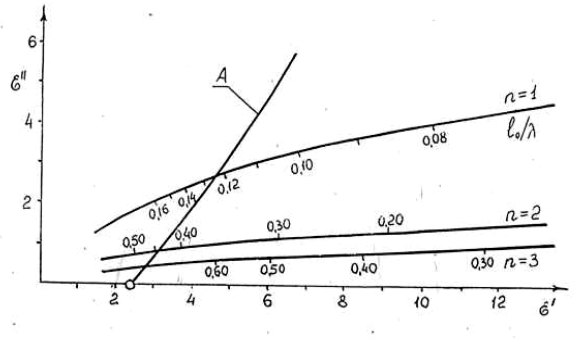

Fig.1. The illustration of the graphical method of the finding of the resonance concentrations of polar component in the absorbent.

Then the points of intersection of this dependence with the curves, described by equations (1) and (2), allow to define the looking for the set of values φ_0 and l_0 for every N value. As the concentration dependence ε′′and ε′ of the concrete mixture it is difficult to express analytically, so we use the graphic method of the finding of resonance values φ_0 and l_0 for their calculation, which was described in the ref [4].

In the table as a example are given the results of the calculation of the parameters of the non-reflecting coverings of the solutions of dimetilformamide-dioxan.

N	φ %	l/λ
1	4	0,1
2	8	0,3
3	19	0,7

CONCLUSION

Thus, the search of the resonance values l and λ, at which the conditions of non-reflecting wave absorption becomes unique. If the frequency dependencies ε"and ε'of the concrete covering material are known. In the dispersion region of the polar substance, its dielectric properties are well described by Debye equations. From the joint solution of Debye equations and equations (1) and (2), it is followed, that any covering substance has the frequency discrete spectrum and the spectrum of the thicknesses of covering layer, corresponding to it, at which the resonance non-reflecting wave absorption effect appears.

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MİKRODALĞALI POLİMER UDUCULAR.

Məqalədə mikrodalğalı binar uducuların tərkibi və qalınlıq layları seçilmə metodikası göstərilib.

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МИКРОВОЛНОВЫЕ ПОЛИМЕРНЫЕ ПОГЛОТИТЕЛИ.

В статье приведена методика выбора толщины слоя и состава бинарных поглощающих микроволновых покрытий.

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