THE NONREFLECTION ABSORPTION OF THE MICROWAVES IN THE SOLUTIONS OF THE ACETONITRIL IN BENZOL

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The conditions of nonreflected resonance absorption for the polar dielectric materials with the regular layer thickness are given.

The obtaining and investigation of the materials, absorbing the electromagnetic radiation without its noticed reflection represent the scientific and especially practical interest. The all possible compositional materials, the technology of the obtaining of which is the comparable simple are the most perspective in this connection.

In the ref [1,2] it was shown, that under the certain conditions in the polar dielectrics, having the wave dispersion and carried out on the metallic substrate, the full blanking of the going through electromagnetic radiation, and its reflection from the conducting surface, can take place. However, the experimental discovering of this effect by the direct investigation of the reflected characteristics in the wide frequency band is troubled by the specifications.

Moreover, the probability of the observing the effect of the full absorption of the electromagnetic radiation was proved by the investigations of the dielectric properties and reflection characteristics of the binary solutions of the polar liquids in the unpolar solvents in the band of the centimeter waves [3,4]. It was established, that the full nonreflection wave absorption appears at the defined layer thicknesses and compositions of the solutions at the given incident radiation frequency and solution temperature. As the revealing of the given effect is possible in the solutions, the polar components of which have the dispersion in the microwave wave region, so the carried out its studying as an example binary solutions, which are different on its dielectric properties of the polar liquids in the same unpolar solvent. They could be used for the working on of the technique of the effect observing of the full wave absorption in the polar solutions on its reflection characteristics on the first steps of these investigations. Taking into consideration, that earlier have been investigated the properties of the aceton-benzol solutions, the solutions of the polar acetonitril in the unpolar benzol, dielectric properties of which have been studied enough in the range of the SHF had been chosen as an object.

The investigations were carried out at the wave length λ=1.5 and temperature 20°C, taking into consideration that dispersion region of acetonitril lies in the region of the centimeter and millimeter waves.

The measurements of the reflecting characteristics of the given solutions were carrying out with the use of the panoramic standing-wave meter P2-66 and I2P-67 and short-circuit measured waveguide cell on the end, connected with it. This cell had been thermostating and had the device for the graded regulation of the thickness of the solution layer. The minimum R_{min} were defining in the cell and investigating their dependences on the concentration of the polar component in the solution on the experimentally taken dependences of the wave reflection coefficient R module on the solution layer thickness l in the cell. The quantitative estimation of the dielectric properties of the investigated solutions was carrying out parallelly with the use of the mentioned in the ref [5] the measurement method. This method is based on the definition of the dielectric constant ε' and dielectric loss $\varepsilon''$of the solution on the data of the measurement of the standing-wave ratio and solution layer thickness l in the point of the first minimum of the dependences R on l. The acetonitril and benzol by the kind ХЧА were using as the components of the investigated solutions.

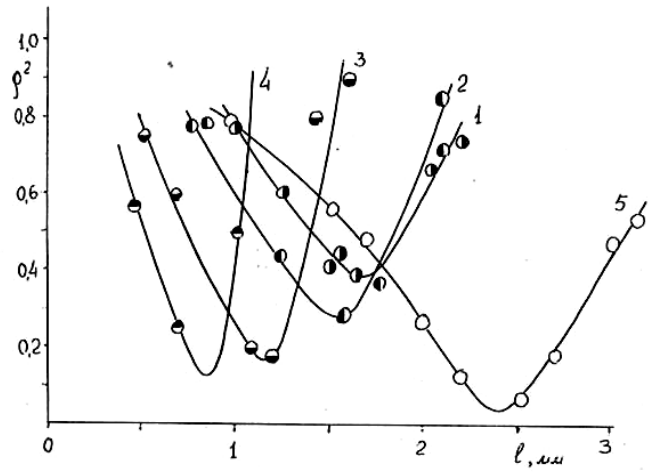

Fig.1. The dependences of the module of reflection wave coefficient R the molecular concentration for the acetonitril-benzol solution at the temperature T=20°C and wave length λ=1,5 cm.

The typical family of the dependences of obtained concentration R_{min} on l for the solutions acetonitril-benzol, obtained at λ=1.5 is given on the fig1. The concentration dependences R of the given solutions have the clear marked zero minimums R_{min}, according to defined values of benzol concentration irrespective of choose of number N of function minimum $R_{min}(l)$. The zero minimum R_{min} of the concentration dependences shifts to the side of the low concentrations of polar component of the solution with N increase. Moreover, the distance between nearest minimums R_{min} decrease and leads to the zero values at big N. At the later increase of benzol concentration in the investigated solution conditions for the appearing of the nonreflected absorption of the electromagnetic waves and at the high values N of function minimums $R_{min}(l)$ will be generating.

Obtained experimental values of the chosen concentrations of acetonitril in benzol are given in the table 1. The selective values φ, obtained by the calculated way with the use of measurement data ε' and ε'' solutions were given also.

The following technique was working for their location. According to the ref [6] the selective values ε' and ε'', at which the full wave absorption in the substance layer takes place, are defined from the following equations:

$$(1+y^2)\cdot\lambda_b/\lambda_g = tg\,(2\pi yx) - y\,tg\,(2\pi x)$$
$$y\cdot sh\,(4\pi yx) + \sin\,(4\pi x) = 0, \qquad (1)$$

where $x=l_0/\lambda_g$, $y= tg\Delta/2$; $\Delta= arc\ tg\ \varepsilon''/(\varepsilon'-p)$; $p = (\lambda/\lambda_k)^2$; $\lambda_b=\lambda/\sqrt{(1-p)}\lambda_b$ $\lambda_b=\lambda/\sqrt{(1-p)}$ λ_b, λ_g, is the length of the electromagnetic wave in the waveguide system, null and fill up by the dielectric correspondingly; λ_k is the critical wavelength of the waveguide; l_0 is the thickness of the substance layer, at which the reflection is absent.

The value l_0, including (1), closes to $(2n-1)\lambda_g/4$ and differs from the last on the small value, depending on the substance properties and number N of dependence minimum R_{min} on l.

As

$$\varepsilon'=p+(\lambda/\lambda_g)^2\cdot(1-y^2);\ \varepsilon''=2y(\lambda/\lambda_g)^2, \qquad (2)$$

so dependences between selective values ε', ε'', $l_0/\lambda g$ have the given type in the coordinate plane [ε', ε''] on the fig.2. The dependence ε'' on ε' increases monotonely with the increase of ε' and at the big values N reaches to the abscissa. The inverse dependence is observed for the functions l_0/λ_g ε' and ε''.

The values ε' and ε'' of the solutions at the different benzol concentrations, obtained in the experiment were using for the construction of the values dependences ε' on ε'' of the corresponding solutions in the same coordinate plane. The coordinates of points of intersection of the experimental and theoretical dependences fig.2 were discovered by the graphical way by their compatibility with the family of the curves selective values ε', ε'', calculated on the equations (1)-(2), and later the corresponding resonance values of benzol concentrations in the solution were observed on them.

As it follows from the table 1 the calculated values of φ are close enough to the experimental ones. The calculated and experimental values of φ for the aceton-benzol solutions, given in the ref [4] are also in the table. They prove the defined influence of the solvent on the effect of the full wave absorption appearance in such solutions.

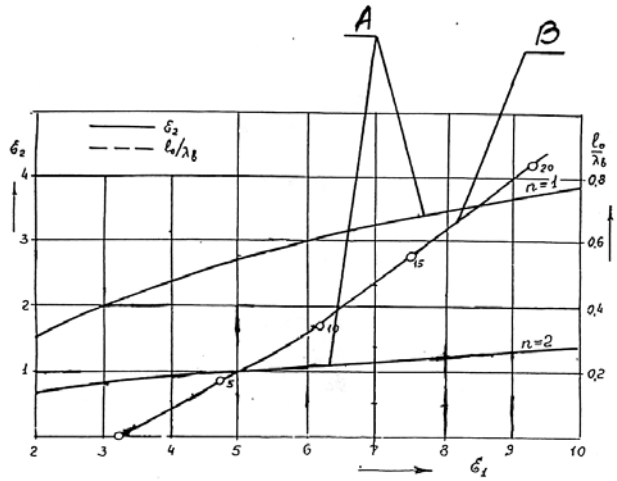

Fig.2. The dependences between values of the dielectric constant ε' and dielectric loss ε'', corresponding to the nonreflected absorption condition of the electromagnetic radiation in the polar substances (A); and obtained experimentally (B) for the acetonitril solution in benzol at temperature T=20°C and wave length λ=1,5cm. The molar concentrations of the polar components of solution in percents.

The studied effect of the selective nonreflected absorption of the electromagnetic waves in the solutions has the common character and can be discovered at the defined selection of the measurement frequency, temperature and composition of the investigated solution.

Table 1

Experimental x and calculated x_p values of resonance polar concentrations of the polar component of solutions of acetonitril and anizol in benzol at temperature 20°C and wave length 1,5 sm.

Solutions ε_0, τ	acetonitril-benzol		anizol-benzol	
	36,8	3,3	4,39	12,3
	X_P	X	X_P	X
number of zero minimums N	19,4	19,4	-	-
1	7,4	6,6	65,0	63,5
2	4,8	4,6	37,2	34,6
3	3,6	3,4	26,0	24,5
4				

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ASETON BENZOL MƏHLULLARINDA MİKRODALĞALARIN ƏKSOLUNMAYAN UDULMASI

Məqalədə qalinliği tənzim olunan polyar dielektrik materiallar üçün əksolunmayan rezonans udulma şərtləri verilir.

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БЕЗОТРАЖАТЕЛЬНОЕ ПОГЛОЩЕНИЕ МИКРОВОЛН В РАСТВОРАХ АЦЕТОНИТРИЛА В БЕНЗОЛЕ

Показаны условия безотражательного резонансного поглощения для полярных диэлектрических материалов с регулируемой толщиной слоя.

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