THE MICROWAVE ABSORBENTS ON THE BASE OF THE HIGH-DISPERSE MATERIALS

S.T. AZIZOV, M.A. SADICHOV, E.R. KASIMOV, CH.O. KADJAR, R.M. KASIMOV
Institute of Physics of Azerbaycan Academy of Sciencies
370143, Baku, H. Javid ave.,33

The results of the investigations of the properties of the solid-state absorbents of microwaves, made on the base polyformaldegide and included in it the high-disperse absorbing fillers are presented.

Protection from the influence of the poison microwave radiation on the alive organisms is the one of the important ecological problems. The important role in its solving has the search of the high-effective wave absorbents on the base of the acceptable compositional materials and simple technology of its preparation. The investigation in this area are carried out in the industrially developed countries, but they are basically directed on the creation of the nonreflecting surfaces for the air and sea ships with the aim of the blanking of the probing radar signals. They didn't accept their usage for the protection of civil population from the microwave radiation action because of the difficulty and expensiveness of these works.

The existing microwave absorbents, as a rule, form on the base of the layer composition from the nonabsorbent matrix dielectric substance and thin-film or high-disperse metallic and ferromagnetic materials [1]. In such layer systems, situated on the metallic substrate, the radiation absorption creates because of the skin-effect in the surface layer of the filler, but carrying out of the selective absorption condition of the incident radiation in the wide band of frequency is achieved by the selection of the defined member and thicknesses of the compositional layers with the different content of the absorbing inclusions in them [2]. These absorbents well justify themselves in the long-wave region of the microwave band. The abilities to the selective absorption of these waves in the used compositional materials deeply decrease because of the increase of the skin-effect action with the increase of the incident radiation frequency. The attempts to compensate this natural effect by the increase of the absorbing fillers concentration in the compositional materials of the covering lead to the increase of the construction covering weight and decrease of its mechanic strength.

Moreover, the investigations of the reflected characteristics of the systems, consisting on the quarter-wavelength layer of the absorbing dielectric carried out on the metallic substrate, show the probability of the obtaining of the nonreflected wave absorption in them [3]. The nonreflected wave absorption is created because of the interference of waves, reflected from the boundaries of mediums division; moreover the demanded ratios of the amplitudes and phases of the reflected waves reach by the way of the selection of the corresponding values of dielectric constant ε', dielectric loss ε'' and thickness of the layer of the covering material. The reality of the existence of the nonreflected wave absorption phenomenon in the layer systems and in the double-layer system dielectric-metal, in particular, is proved theoretically and experimentally on the example of the investigations of the reflected characteristics of the polar molecular solutions in the microwave region [4]. The selective absorption in such systems is carrying out at the small thicknesses of the covering layer and can be realized in the more wide wave region, including the short-wave region of millimeter wave band. The character peculiarity of the selective wave absorption in the layer of polar dielectrics is existence of the frequency spectrum and, discrete thicknesses of the substance layer at which the conditions of the nonreflected (total) absorption of the incident radiation. They are individual for every substance and depend on their dielectric static and dynamic characteristics.

The access of the dielectric materials does their usage perspective at the creation of the cheep microwave absorption systems on their base with the use of the simple technology of their preparation. Moreover, they can be done from the solid-state matrix nonreflected dielectric material, including the high-disperse absorbing stolid or capsulated liquid dielectric materials, for the improvement of the mechanic strength of the solvents.

The experimental investigations of the solid-state solvents of the microwave radiation on the base of nonabsorping polyformaldegide and introduced in it high-disperse absorbing fillers from aluminium and polyamide with the particles size 30-50 [5], were carried out with the aim of the check of these positions. The choose of the aluminium and polyamide as fillers was sent for the necessity of the carrying out the comparable analysis of two types of the absorbents, differing by the nature of the creation of the appearing of the absorption of high-frequency radiation in them. If in the case of the aluminium absorption of incident radiation takes place in the metal surface layer because of the skin-effect, so in the polyamide case, having the wave dispersion in the super high-frequency region, the absorption of incident radiation is because of the volume hindered orientation of dipole groups in the direction of the applied field [6].

The measurements of characteristics of wave reflection absorbents were carried out at the wave length 1,5sm and temperature 20°C with the use of the experimental device, switched on throw waveguide tract to the panoramic standing-wave meter. The change of the value of wave reflection coefficient ρ and energy relative value E of reflected wave were carrying out in the dependence on the thickness of absorbent sample (fig.1), situated in the end of the cell on the metallic reflected substrate. As examples were used the pressed sets of disks of the different thicknesses with diameter 15mm at the pressure 10 atm. The disks were formed from the carefully mixed mixture of the powdery

polyformaldegide and polyamide or aluminium. The content of polyamide and aluminium in the samples was regulating in the limits of weight 1-25%.

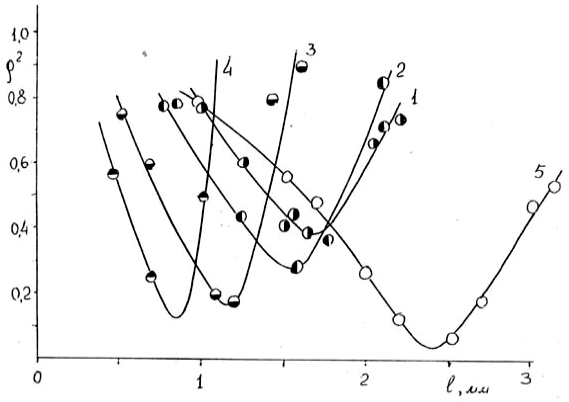

Fig. 1. The dependences between relative energy value of electromagnetic radiation *E*, reflected from the covering, and the thickness of covering l from polyformaldegide at temperature 20°C and wave length 1,5 sm. The high-disperse fillers of covering: aluminium 3(1), 5(2), 10(4) and polyamide 5(5) with weight content in percents.

The optimal values of samples thicknesses of covering of different compositions were defined by the results of the carried out experiments, at which the relative values of reflected energy *E* are minimal. From the dependences, given in the fig.1, it follows, that in the case of the usage of aluminium as a filler or polymeric covering the minimum of value *E* decreases with the increase of weight content формула of the filler in the covering material and achieves value 0,1 at φ=10%. The following increase of content φ of aluminium in the covering makes worth its mechanic strength and leads to the narrowing of the selective absorption band of radiation. The covering, made on the base of the mixture of polyamide and polyformaldegide were the most technological at the preparation, opposite to the aluminium coverings. Practically, total wave absorption (*E*=0,02) appeared at the polyamide content 5%. The obtained covering had the big thickness in the comparison with the coverings with the aluminium use, but had the better band of selective wave absorption.

The decrease of the thickness of the dielectric coverings can be achieved, if as fillers will be used the strongly absorbing materials, in particular, the liquid polar dielectrics, having dispersions in the SHF region. Their use especially prefers in the short-wave part of SHF region. Moreover, for the constructive solving of the problem of absorbents creation of the electromagnetic radiator the material of the absorbing covering should have the defined adhesive properties in respect to the metallic base. The elimination of these two contradictory demands to the absorbents material of the electromagnetic waves can be achieved by the use of the last by the composition from nonpolar solid dielectric with good adhesive properties to metals and uniformly distributed in its volume high-disperse inclusions from low-molecular polar liquids, having wave dispersions in SHF region.

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S.T. Əzizov, M.A. Sadıxov, E.R. Qasımov, Ç.O. Qacar, R.M. Qasımov

YÜKSƏKDİSPERSİYALI MATERİALLAR ƏSASINDA MİKRODALĞALI UDUCULAR

Məqalədə poliformaldehid və yüksək dispersiyalı uducular daxil edilmiş poliformaldehid əsasında bərk mikrodalğalar uducularının xassələrinin tədqiqinin nəticələri verilmişdir.

С.Т. Азизов, М.А. Садыхов, Э.Р. Касимов, Ч.О. Каджар, Р.М. Касимов

МИКРОВОЛНОВЫЕ ПОГЛОТИТЕЛИ НА ОСНОВЕ ВЫСОКОДИСПЕРСНЫХ МАТЕРИАЛОВ

Приведены результаты исследования свойств твердотельных поглотителей микроволн, выполненные на основе полиформалдегида и внесенных в его высокодисперсных поглощающих наполнителей.

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