UDC 621.396.946

SCATTERING OF ELECTROMAGNETIC WAVES ON DIFFERENT DIELECTRIC RESONATOR STRUCTURES

Trubin A. A.
National Technical University of Ukraine "Kyiv Polytechnic Institute"
E-mail: atrubin@ukrpost.net

РОЗСІЮВАННЯ ЕЛЕКТРОМАГНІТНИХ ХВИЛЬ НА СТРУКТУРАХ РІЗНИХ ДІЕЛЕКТРИЧНИХ РЕЗОНАТОРІВ

Проведено узагальнення електродинамічної теорії розсіювання електромагнітних хвиль лінії передачі на системах відмінних по формі та діелектричної проникності діелектричних резонаторів. Досліджені частотні залежності матриці розсіювання смугових та режекторних фільтрів, побудованих на різних формах ДР.

In constructing the theory supposed that all resonators have the same form and consists from the same dielectric. To improve the parameters in some cases there is need to build filters on different form DRs made from variant dielectrics. However, in this case it becomes much more complicated theory, describing scattering processes on such structures. We find the system of equations, describing different DR structures. Found total solution. In the special case of identical resonators obtained solution becomes known [1].

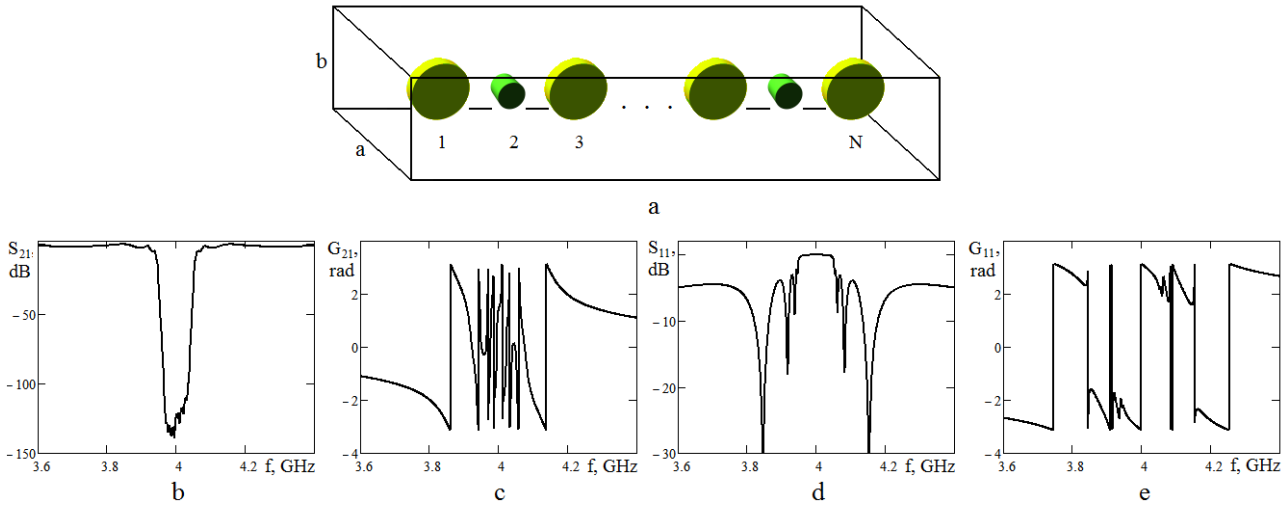

Fig. 1. Different Cylindrical DR structure on the symmetry axis of propagating Rectangular metal waveguide (a). S-parameters (b - e) of the bandstop filter on 9 Cylindrical DRs with $\varepsilon_{1r} = 36;\ \varepsilon_{2r} = 82$.

Using obtained equations we present here the results of the study process of the scattering of electromagnetic waves on the different DR structures in the propagating

waveguide as well as evanescent waveguide segment. It is assumed that all the resonators are excited by the main type of natural oscillations of the magnetic type.

Fig. 1 shows scattering parameters of the bandstop filter, consisting of 5 Cylindrical DRs characterized by the dielectric permittivity $\varepsilon_{1r} = 36$ and by the relative size $\Delta_1 = L_1 / 2r_1 = 0,4$ as well as 4 DRs with $\varepsilon_{2r} = 82$; $\Delta_2 = L_2 / 2r_2 = 0,8$. Here $2r_s$ - is the diameter; L_s - is the height of the s-th DR ($s = 1,2$). The distance between the centers of adjacent DRs was equal to $\lambda_w / 4$, where λ_w - is the waveguide number.

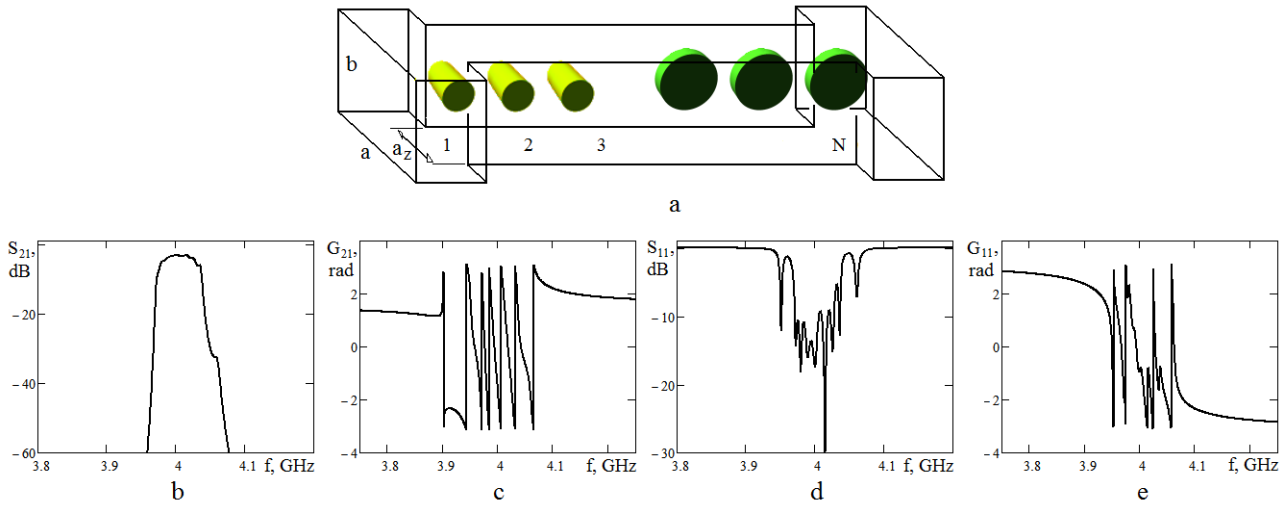

Fig. 2. Cylindrical DR on the symmetry axis of evanescent Rectangular metal waveguide segment (a). S-parameters of the bandpass filter on 11 Cylindrical DRs with $\varepsilon_{1r} = 36$; $\varepsilon_{2r} = 82$.

The best results were obtained for the DR structures located in the evanescent waveguide segment and forming bandpass filter. It's desirable the filters containing the DR should have a clean bands free of spurious oscillations. The solution of this

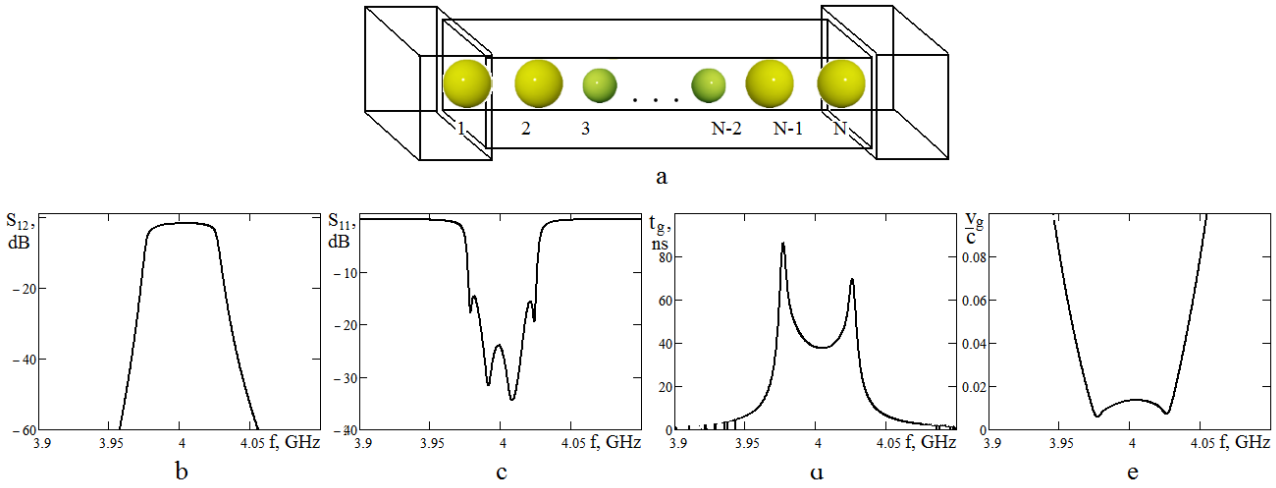

Fig. 3. Different Spherical DRs in the evanescent Rectangular metal waveguide segment (a). Scattering parameters of the bandpass filter on 11 Spherical DRs with $\varepsilon_{1r} = 36$; $\varepsilon_{2r} = 82$.

problem is known possible using different DRs.

Fig. 2 shows scattering parameters of the filter, consisting of two lattices different Cylindrical DRs. First lattice containing 4 DR with $\varepsilon_{1r} = 36$, $\Delta_1 = 0{,}8$, the second lattice consists from 7 DR with $\varepsilon_{2r} = 81$, $\Delta_2 = 0{,}4$. The distance between the centers of adjacent first type DRs was equal to 17 mm; for the second type DRs 21 mm.

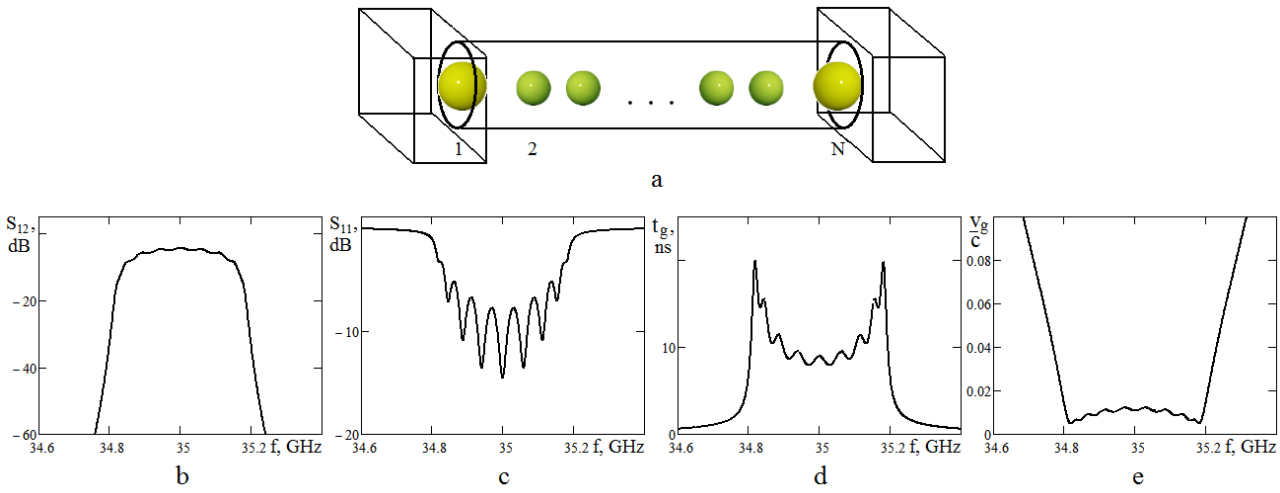

Fig. 4. Different Spherical DRs in the evanescent Cylindrical metal waveguide segment (a). Scattering parameters of the bandpass filter on 11 Spherical DRs with $\varepsilon_{1r} = 36$; $\varepsilon_{2r} = 82$.

The use of different Spherical DRs also could improves the filter parameters. Fig. 3 shows 8 DR bandpass filter scattering matrix. Recent resonators filter made of dielectric with $\varepsilon_{1r} = 36$, $Q_1^D = 3000$, the rest are made of dielectric $\varepsilon_{2r} = 81$, $Q_2^D = 2000$. All resonators form symmetrical structure. The distance between the centers of first and second DR is 23,5 mm, among other DRs is 20 mm. The cross section of the input and output waveguides $a \times b = 58 \times 25 mm^2$, the cross section of the evanescent waveguide $az \times bz = 20 \times 25 mm^2$.

Fig. 4 shows 11 Spherical DR arrangement in Circular Cylindrical metal waveguide. The cross section of the input and output waveguides $a \times b = 7 \times 3 mm^2$; the radius of the evanescent waveguide $Rz = 1{,}5 mm$.

Thus, the use of different DRs can greatly enhances design filters. As shown by preliminary calculations, the developed model correctly describes the scattering processes in the system of different DRs in a variety of transmission lines.

References

1. A.A. Trubin, Scattering of electromagnetic waves on the Systems of Coupling Dielectric Resonators, Radio electronics, №2, 1997, pp. 35-42.