ABSORPTION PROPERTIES OF MICROSTRIP ARRAY OF C-SHAPED ELEMENTS

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Abstract. The absorption electromagnetic properties of double periodic microstrip structure consist of complex strip elements particularly C-shaped elements are studied.

Let us consider the periodical microstrip structure that is shown in the Fig 1. The strip elements of grating can to have a complex shape particular the shape of the letter C, see Fig 2. Elements of array are suggested infinitely thin. Metal elements and background of array are ideally conductive. Dielectric of substrate of microstrip array is a homogeneous isotropic loss media absorbing electromagnetic energy.

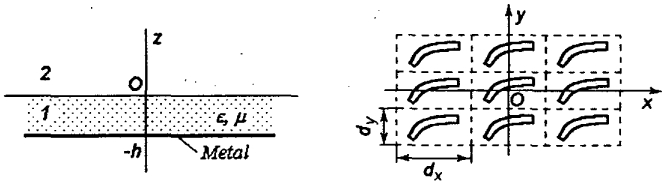

Fig. 1. Microstrip array of complex particles

The microstrip periodical structure of complex shape strips can be used as transformer of polarization of a reflected electromagnetic field, scattering sheet [1-4] and absorber in case a loss medium of substrate. These arrays are polarized selective and frequency selective surfaces.

The complex shape stripe particle of microstrip array can has straightened length that is more then a wavelength and to be placed in limits of one period of an array which is less of a wavelength. The array with such elements has resonance properties in low frequencies at which a wavelength is significant more then array period.

For simplicity let us restrict the consideration to normal incidence and frequency region in which only single main partial space wave can propagated in reflected field. The both periods of grating are smaller then wavelength in this frequency range. We can define the operator of reflection of microstrip

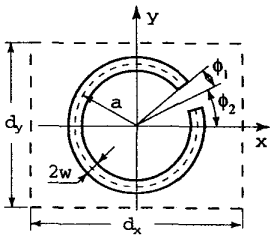

Fig. 2. C-shaped strip particle

structure as two-dimensional matrix in above assumption

$$\hat{r} = \begin{pmatrix} r_{xx} & r_{xy} \\ r_{yx} & r_{yy} \end{pmatrix}$$

Field time dependence is assumed in the form $e^{i\omega t}$.

Non-diagonal elements of matrix of reflection operator are equal to zero if C-shaped strip particles of array (see Fig.2) are symmetric regard to axis Ox or axis Oy.

The method of moments with expansion of a field in plane waves is used. The method of moments enables numerically to find a solution of an integral equation regard to a surface current on strip particles of the complex shape in two periodic arrays [3, 4]. If the surface current density is found, it is easy to derive the expression for reflected field as superposition of partial space waves. The elements of matrix of reflection operator are found by using these field expressions.

The dependence of r_{yy} versus value $\kappa = d_x / \lambda$ that proportionate to frequency has resonant behavior, see Fig. 3. The strong absorption of line y-polarized electromagnetic wave is observed in the frequencies near the resonant frequency of microstrip element of array. The deepest minimum of reflection is arisen at the some of value of image part of substrate permittivity. If dielectric losses increase more then this value the reflection is increase also because an electromagnetic field weekly penetrated in the substrate.

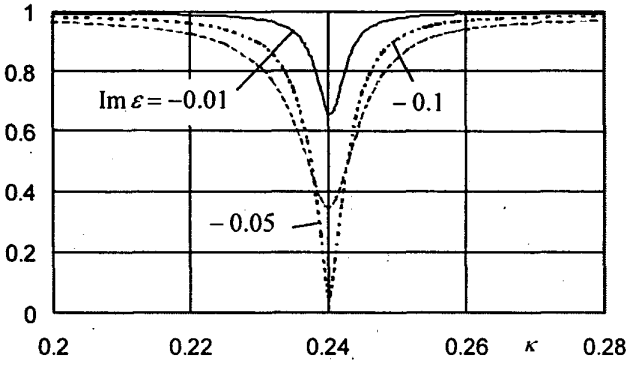

Fig. 3. Absolute value of the reflection coefficient r_{yy} of microstrip array of C-shaped elements ($a/d_x = 0.3$, $\phi_1 = 15°$, $\phi_2 = 0°$, $2w/d_x = 0.05$, $\mathrm{Re}\,\varepsilon = 2$, $\mu = 1$, $h/d_x = 0.15$)

The frequency dependencies of the reflection coefficients of microstrip C-shaped array exited by two orthogonal polarized incident waves are shown in the Fig 4. Three resonances are arisen at frequencies corresponding straight length of array particle approximately equal to half of wavelength, wavelength and one and half of wavelength of corresponding microstrip line respectively.

The properties of microstrip array of complex shape of particles to absorb and to transform polarization of incident wave can be useful for creating the weekly back reflecting thin cover.

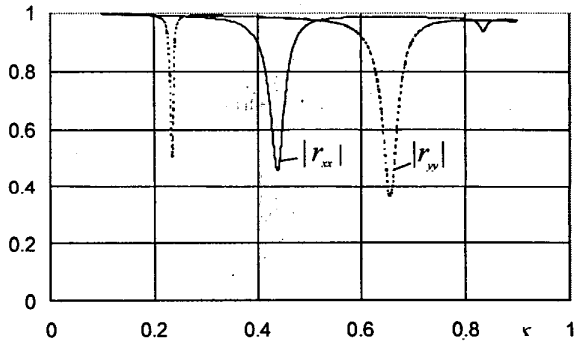

Fig. 4. Reflection coefficient of microstrip array of C-shaped elements ($a/d_x = 0.3$, $\phi_1 = 15^\circ$, $\phi_2 = 0^\circ$, $2w/d_x = 0.05$, $\varepsilon = 2 - i0.05$, $\mu = 1$, $h/d_x = 0.1$)

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