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Investigation of Electrical Parameters of the Samples of Optical Materials in a Decimeter Wavelength Range

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Abstract—Semiconductors, being the intermediates between conductors and dielectrics, possess the properties of both conductors and dielectrics. There are few studies devoted to the consideration of dielectric properties of semiconductor materials. In this study, dielectric properties of zinc selenide and germanium in a decimeter wavelength range are investigated. The results of investigation indicate the possibility of using these materials in new promising directions of microwave electrical engineering.

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The reliable measurement of intrinsic parameters of dielectric and semiconductor materials in a microwave range is a topical problem in the development of a new generation of electrotechnical materials, articles, and devices on their basis.

In this study, the samples of materials of the optical wavelength range—zinc selenide (ZnSe) and germanium (Ge)—were for the first time investigated as the dielectric resonators (DR) of the decimeter wavelength range. To compare the results of measurements, the experiment was performed using two measuring installations with the waveguide section and cylindrical section.

In the waveguide variant, the cylindrical ZnSe sample under study with diameter $d = 30$ mm and thickness $h = 12.5$ mm, which consisted of two parts with $h_1 = 6.2$ mm and $h_2 = 6.3$ mm, was placed into the cavity of a rectangular metal waveguide with sizes $a \times b = 57 \times 120$ mm^2, installed near the narrow wall, and excited by oscillations of the lower type $H_{01\delta}$.

The cylindrical Ge sample with diameter $d = 25$ mm and thickness $h = 7.9$ mm was installed in a waveguide similarly to the ZnSe sample. In both cases, the pattern of the electromagnetic field of the samples under study excited by oscillations of the lower type $H_{01\delta}$ is similar to the field pattern of the magnetic dipole. In this case, component H_z is perpendicular to the plane of the sample disc.

Figure 1 shows the normalized dependence of amplitude H_z of the microwave component of the magnetic field in the vicinity of the ZnSe sample under study, which confirms the correct selection of the working type of $H_{01\delta}$ oscillations. This dependence is represented in relative amplitudes $F_z = H_z/H_{z\max}$, where axis z is directed H along a wide waveguide wall.

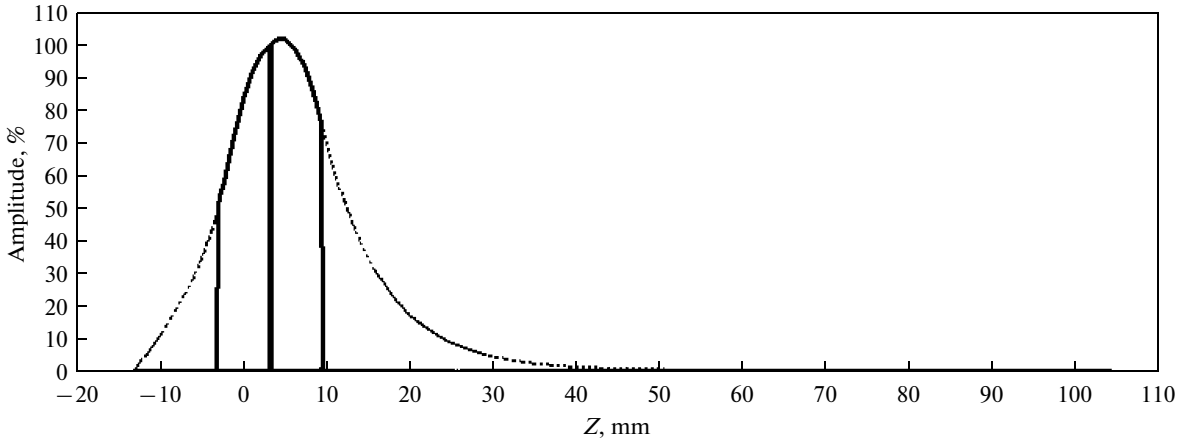

Fig. 1. Dependence of the relative field amplitude (H_z component) of the ZnSe sample mounted inside the waveguide.