Plonų laidžių plėvelių elektromagnetinės savybės mikrobangų ir teraherciniame dažnių diapazonuose

Characterization of electromagnetic properties of thin resistive films in microwave and terahertz ranges

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Thin resistive films are widely used as a base for metamaterial absorbers [1]. In our previous studies such multilayered absorber, designed on the basis of commercially available resistive toning films, was shown to exhibit good absorbing ability in the radio wave range [2]. Obtained structures absorb more than 90% of electromagnetic energy in 8-78 GHz frequency range. Nevertheless, intrinsic absorbing properties of thin toning films are thoroughly investigated in visible range, while there absorbing properties in microwave-terahertz range are still obscure. In the present study commercially available toning films with different transparencies in visible region were experimentally investigated in microwave (12-18 GHz) and terahertz (0.2-1.0 THz) frequency ranges.

Two series of car toning films (Solartek, Russian Federation) were investigated. The first series of samples comprise toning films "Black plus" (BL) with transparencies 5-45%. These films are layered structures, in which the light reflection occurs on a metallized layer. The second series consists of the structures "STR CHSRPS" (CH) with transparencies 5-50%, in which light reflectance is due to the presence of a carbon layer. Measurements in 0.2-1.0 THz and 12-18 GHz ranges were performed via time-domain terahertz spectrometer T-Spec (EKSPLA, Lithuania) and via vector network analyzer Micran R4M-18 (Micran, Russian Federation), respectively.

Samples of both series with similar optical properties demonstrate significant difference in their electromagnetic response in microwave and terahertz ranges. The metal-based films of BL series are almost transparent for microwave and terahertz radiation. On the contrary, the carbon-based films of CH series demonstrate significant reflectance ability depending on their optical transparency. All studied samples have almost non-dispersive reflection/transmission spectra in the considered frequency ranges (Fig. 1).

We found that the S_{12}-parameter changes for more than 2 dB when moving from microwave to terahertz range only for the CH sample with 5%-transparency. Samples of CH series also show good correlation between optical transparency and reflection/transmission spectra in microwave and terahertz ranges. The more is the transparency in the optical region, the larger is the S_{21} parameter in microwave and terahertz range.

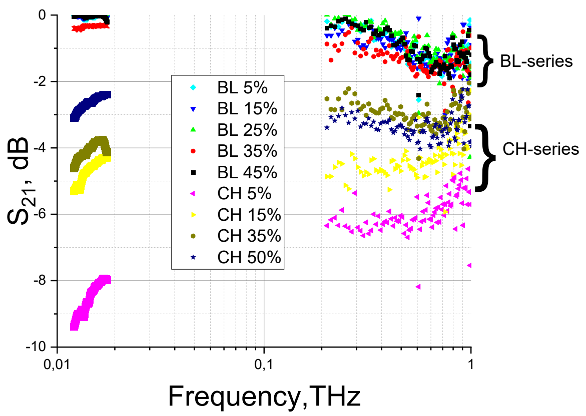

Fig. 1. Broadband S_{21} spectra of studied samples.

Thus, the investigated materials demonstrate significant potential for practical use in Salisbury screen or Jaumann absorbers design for radars [3], solar radiation absorption [4], microwave absorption [5], etc.

Keywords: resistive toning films, microwave and terahertz ranges, absorbing structures.

Literature

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