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# Prospects of a Slotline Utilization as the Excitation Element of a Quasi-Optical Hemispherical Resonator for the Problems of Liquids Dielectrometry

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**Abstract**—In this article we propose the utilization of a quasi-optical resonator in the form of the resonant cavity of hemispherical shape in the metal as a measurement cell of a dielectrometer for the investigation of electrophysical properties of liquids. We have carried out the investigations of electromagnetic characteristics of the utilized resonator in the case of the air filling and of the partial filling by the analyzed liquids (benzene, butanol, ethanol, methanol). The possibility of effective excitation of whispering gallery modes using the slot line has been demonstrated. We have determined the possibilities of the utilized investigation technique of the electrophysical properties of different liquids and of their identification based on the variations of electromagnetic characteristics of the proposed measurement cell. It has been shown that in the case of a small perturbation of the resonance fields by samples of liquids (with volume up to 3 ml) this technique for the proposed resonator possesses a high sensitivity and resolution capability for the identification of liquids with a relatively small difference of the electrophysical parameters.

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## INTRODUCTION

One of the promising directions of the development of modern radio physics is the utilization of interaction effect of the electromagnetic waves of various frequency ranges with the matter in order to determine its electro-physical (dielectric) parameters [1–3]. The dielectrometry techniques allow one to identify a wide range of dielectrics based upon the experimentally determined values of the complex permittivity. In most cases the exact solution of the equations describing the electromagnetic system, which include the analyzed sample of dielectric, is associated with a variety of difficulties. In such cases one utilizes the reference samples of different dielectric materials, which serve as reference points for further investigations of similar dielectrics.

At the present time the resonator dielectrometry techniques are well developed for the investigation of a wide range of dielectric materials both with small [3, 4], and with high energy losses, such as liquids are [5, 6]. In [5] the authors have developed a resonator approach for the investigation of liquids in small volumes based upon the utilization of a high Q-factor layered hemispherical resonator with whispering gallery modes.

However, one of the main problems of experimental studies of dielectrics using high-Q quasi-optical resonators with the whispering gallery modes is their excitation. The emplacement of local excitation element of oscillations in the region of their localization inside the resonator inevitably leads to the perturbation of the resonance field and to the distortion of inherent characteristics of the resonator. The occurrence of external factors of the perturbation of the resonance oscillations fields negatively affects the sensitivity and the resolution capability of measurements in the case of dielectrometry problems solving by the resonator technique.

In reference with the above the vital and important problem of dielectrometry is the search of novel ways of whispering gallery modes excitation in the quasi-optical resonators with minimal disturbance of the resonance fields.

In this paper for the excitation of the quasi-optical hollow metal resonator of a hemispherical shape we suggest the utilization of a slot line [7], which allows one to locate the source of oscillations excitation