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# AN ACTIVE QUASIOPTICAL MEASURER OF PHYSICAL PROPERTIES OF MATERIALS

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**The paper describes the design of an active system, with a quasioptical generator as its main part, for measuring physical properties of materials. The results of experimental investigation of the device for measurement of moisture content in materials are presented.**

The radio-wave methods for measurement of physical properties of materials are based on dependence of various parameters of radio-wave transducers on electromagnetic characteristics of the objects under test. Of particular interest are active systems of measurement, i.e., systems in which the measuring element, together with a specimen to be tested, is connected to the resonant system of a microwave generator [1]. The frequency and level of the generator output signal make it possible to get information concerning physical properties of the specimen. Owing to high accuracy of frequency measurements, the active system is also particularly accurate. In addition, such systems permit us to obtain a small time constant and a large dynamic range of measurements. Moreover, their overall dimensions are substantially less compared to those of passive devices.

For measurement of materials' properties, a generator with a quasioptical resonant system is suggested. In this system the role of the measuring element is played by an open resonator (OR). Excitation of the OR is performed by a lateral-planar active transistor module [2]. The element of coupling of the transistor to the resonator is a slot antenna (SA) connected into the negative feedback circuit of the generator. The main part of the device is a two-mirror half-symmetric OR (Fig. 1) put into the "reflection" mode of operation. The active module is placed in the center of a stationary flat mirror. The spherical mirror of the resonator is mounted on a threaded shaft. The distance between the mirrors can be varied by rotation of the spherical mirror around its axis. The generator has a waveguide output of standard cross-section for connection of measurement devices. The specimen under test is fixed in a special frame-holder. By moving the frame with the material along the resonator, we can vary the meter sensitivity. When the specimen is put in the point with maximum field, the sensitivity will be maximum. To prevent radiation of microwave energy into the surrounding space, the open resonator is placed in a metal casing (not shown in the picture).

The system is used for measurement of moisture content in materials. The principle of operation of the device is based on the considerable difference between complex permittivities of water and the material under test. Because of this, the output signal characteristics of the generator mainly depend on moisture content in the substance.

The studies were performed in the range of frequencies from 8 to 9 GHz. During the measurements, a dry specimen and that to be tested are inserted into the OR cavity. The presence of moisture in the material results in an absolute shift of generation frequency by some $\Delta F$ value in proportion with water content in the specimen. The moisture content was determined by experimentally obtained dependencies of $\Delta F$ on moisture content for each type of material. An example of experimental dependencies of the frequency shift $\Delta F$ on moisture content $W$ for two different types of cotton fabric is

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