OPTIMIZATION OF FREQENCY RESPONSE OF RESISTIVE SENSOR FOR HPM PULSE MEASUREMENT*

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Recently high power microwave pulses are used in different physical investigations and military projects. A waveguide-type resistive sensor (RS), the performance of which is based on electron heating effect in semiconductors, has found application for high-power microwave (HPM) pulse registration in transmission lines and free space. A sensing element of the RS made from n-type Si is inserted into waveguide under thin metal diaphragm. Electric field of microwave pulse heats electrons in the sensing element, its resistance increases and by measuring this resistance change pulse power in the waveguide is determined. The RS demonstrates some advantages over the conventional diode. It can measure HPM pulses directly, is resistant to large power overloads and demonstrates very good long-term stability. Using dc pulse supply, the RS can produce an output signal of the order of a few tens of volts without any amplification and can resolve nanosecond duration microwave pulses. Unfortunately, sensitivity of the RS strongly depends on frequency. Therefore, our recent efforts were focused on improvement of frequency response of the RS.

In this contribution we present the results of the optimization of frequency response of the RS. Making use of FDTD method, the peculiarities of the interaction of the sensing element with electromagnetic wave in the waveguide have been investigated. It was found that the average electric field in it is strongly influenced by resonance occurring in such structure. For the sensor made from low and high specific resistance material odd and even half-wave resonance under the diaphragm appears. Resonance frequency depends on diaphragm length and cross sectional size of the sensing element. The increase of specific resistance in the case of odd resonance as well as the decrease of it in the case of even – leads to the broadening of resonance pike and to the total disappearance of it. Making use of this feature the RS with flat frequency response has been engineered by properly choosing the values of electrophysical parameters of the RS. Calculated maximum to minimum sensitivity ratio 1.09 was obtained for the optimized RS in waveguide's frequency band. Theoretical predictions have been proved experimentally. The largest experimentally measured maximum to minimum sensitivity ratio was 1.2 for the particular RS in waveguide's frequency band. The optimized RS is characterized by smooth dependence of the sensitivity on frequency and this improves its application for HPM pulse measurement in a wide frequency range.

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