Near-field resonant sensors for scanning microwave microscopy

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Abstract – the results of numerical investigation into the most widely used versions of near-field resonant sensors for the SMM are generalized and the main concepts of their theory are formed in the report.

Key words – Microwave microscopy, Resonant sensor, Sensitivity, Resolution.

I. INTRODUCTION

At present the near-field scanning microwave microscopy (SMM) is being developed intensively in the direction of forming a part of nanophysics, nanoelectronics and nanotechnologies tools along with AFM and STM [1, 2]. In this case the multiparametric diagnostics of semiconductor, ferromagnetic and superconducting materials by means of SMM is attractive, while the increase in sensitivity and spatial resolution are conjectural.

Functionally the near-field microwave sensor is the most important in the SMM. The cavity type sensors are the most prospective ones among its many versions [3, 4]. Despite a considerable quantity of works on the SMM technique, till now there is no the general theory of these sensors based on the all-round electrodynamic analysis.

II. MAIN PART

The experience of numerical investigations into the most used versions of near-field cavity sensors for the SMM is generalized and the fundamental concepts of their theory are formed in the report.

The essential influence of losses on radiation in estimations of sensor quality and its change at a variation of characteristics of investigated object proved theoretically and confirmed experimentally is the major of them.

This position is illustrated convincingly by the dependences presented in Fig. 1, where $\varepsilon_2$ and $\varepsilon_2$ are electric characteristics of semi-infinite object under control; $L$ is a slot size between the sensor and the object; $\lambda$ is a wave length of the cavity sensor the working oscillation ($\lambda$= 23 sm).

The following important position is associated with the possibility of simultaneous increase in sensitivity and spatial resolution of the sensor by separate optimization of its storage part and the measuring aperture proved theoretically and experimentally [4].

The action the storage part and measuring aperture storage on the quality and sensitivity of the cavity sensors of different structure is investigated quantitatively in this work.

Fig. 1 Dependence of quality on the size of the slot between the sensor and the object

The results of the investigation into the structure of the field in the sensor aperture are also important as they give grounds to its optimization the criteria of the specified problem.

III. CONCLUSION

Foundations of the general theory of cavity sensors for SMM are base on their detailed electrodynamic analysis with the obligatory account for radiation losses and action of the edge form of the coaxial microprobe on the near-field structure.

REFERENCES