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SUMMARY OF THE DISSERTATION

TOPIC „New piezo-active dielectric structures"

The development and significance of research into materials exhibiting piezoelectric properties is due to the constant increase in electrical energy demand. In recent years, great interest has been observed in the field of the energy harvesting resulting from mechanical stresses.. The application of piezoelectric transducers with optimally selected piezo-active material leads to more effective harvesting. Thus, the new piezoelectric structures with stable and well-known parameters using simple and low-cost technologies are being searched.

The subject of the dissertation concerns piezo-active structures made of electret materials. The piezoelectric phenomena, occurring in the presented structures, is an effect of inhomogeneous deformation of the material bulk with the stored electric charge. Nowadays, the gas-electret composites are being used in piezo-active structures, however, the fabrication of such structures requires complex and complicated processing technology of polymer material. In the dissertation new solutions of piezo-active structures (without the processing of electret material) such as piezo-tubes and succeeding structures such as piezo-capsules and piezo-fabric made of electret tube were presented.

A theoretical model of piezo-tube enabling assessment of piezoelectric coefficient d_{33} based on main geometric and electrical parameters of the tube. The prototypes of piezoelectric transducers made of electret tubes (with different geometric dimensions) and related structures (i.e. piezo-fabric and piezo-capsules) were presented. The possibility of piezoelectric properties activation of structures in high electric field was proposed and mechanical (i.e. Young's modulus) and piezoelectric properties (i.e. coefficient d_{33}) were investigated experimentally.

Moreover, the construction of the piezoelectric structure consisting of electret and elastomeric layers was presented. Two different samples were studied: layered transducer made of electret film and perforated elastomer and transducer with piezo-capsules immersed in an elastomeric matrix. For both transducer solutions theoretical models determining their electromechanical properties were presented. The essential advantage of those piezo-active structures is possibility to application of non-electret dielectric, flexible, low-cost and easy to process elastomeric materials.

The validity of the theoretical models proposed in the dissertation were confirmed experimentally. It can be assumed that research on the piezo-active structures will be continued, mainly in the context of patents concerning the application of non-homogeneous dielectric structures in the construction of low-cost, large-size piezoelectric transducers.

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