

OPINION

**on a dissertation work for the acquisition of the educational and scientific degree
"Doctor" in**

field of higher education: 5. Technical sciences

professional direction: 5.2. Electrical engineering, electronics and automation

doctoral program: Microelectronics

Author of the dissertation: M.Sc.Eng. Romyana Angelova Stoyanova

Topic: DEVELOPMENT OF INNOVATIVE METHODS AND MECHANISMS FOR ENERGY PIEZOHARVESTERS

member of the scientific jury: Prof. Dr. Eng. Nikolay Dimitrov Madzharov

1. Topic and topicality of the dissertation

Systems for generating electrical energy, through mechanical vibrations of the vibratory and compression type, are used in a number of high-tech industrial facilities, mostly with small power. The specific applications are related to the type of piezoelectric harvester and its load characteristics satisfying the parameters of the powered consumers. The interest in this topic has been significant in recent years, which is expressed in the numerous scientific conferences and publications with the participation of authoritative scientific teams and innovative companies. The obtained scientific and applied results have been reported at scientific conferences with international participation and are used in the educational process of dep. "Electronics".

2. Research methodology

The research methodology includes a thorough review of up-to-date literature and patent information and, based on this, determining the purpose and tasks of the dissertation. Secondly, the use of a numerical and simulation method, through which an analysis of the electromagnetic and electrical processes of vibration and compression type harvesters was performed and a planar construction model based on the resistance of different materials in vertical and horizontal effort. When studying the theoretical and laboratory models, two variants of planar construction of a compression piezoelectric harvester and a methodology for their research are proposed. The third level of research is based on the experimental method, which is applied to prove and evaluate the reliability of the results obtained from the numerical method and the stimulation study. A design has been created for more efficient energy collection by reducing the distance between the active elements of the harvester, the effectiveness of which has been proven through the experimental studies.

3. Contributions of the dissertation work

I believe that the main contributions of the dissertation work have a scientific-applied and applied nature with relevance and utility to electromechanical devices that generate electrical energy in the range of several hundred nW to 10 μ W, based on the piezoelectric effect.

The scientific-applied contributions relate to the synthesis, design and analysis of advanced equivalent circuits of a beam-type vibrating piezoelectric harvester, reflecting real operating conditions. The elements of the proposed equivalent circuits reflect some of the variable parameters in the operation of this type of harvesters (such as parasitic capacitances), as well as the parameters of the elements external to the circuit, which have an impact on the operation of the harvester. A model of the planar construction of a compression-type piezoelectric harvester was created, which reflects the features of the elements that make up this device and is based on the basic principles of the resistance of materials under vertical and horizontal stress.

The applied contributions include the results of the experimental work related to the created structure for more efficient energy harvesting by reducing the distance between the active elements of the harvester. The adequacy of the AV and VA type measurement schemes used, as well as the combination between them, was evaluated.

4. Publications and citations of publications on the dissertation work

The main results obtained in the dissertation work are presented in five scientific publications in the period 2019 - 2022. In three M.Sc.Eng. Romyana Angelova Stoyanova is in first place, and one of them is independent. Three of the publications are referenced and indexed in the SCOPUS electronic database. Three were published at conferences in Bulgaria (Scopus) and two at the international scientific conference Unitech 2019 and 2022.

Two more significant citations were found in scientific publications, referenced and indexed in world-renowned databases. At the moment mag. Eng. Romyana Angelova Stoyanova has a Hirsch index of 1.

On the groups of indicators for the implementation of the minimum national requirements, M.Sc.Eng. Romyana Angelova Stoyanova has presented evidence for collected points as follows:

Group of indicators A (at least 50 points) - dissertation work. ***Total 50 points.***

Group of indicators Γ (at least 30 points) - Γ 7 publications in publications that are referenced and indexed in world-renowned databases - 3 nos. publications with different number of authors – 100 points; Γ 8 publications and reports published in non-refereed journals with scientific review or published in edited collective volumes - 2 pcs.

