



OPINION

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

Author of the dissertation: **M.Sc. Eng. Martin Lachezarov Ralchev**

Dissertation topic: **Emission and sensor registration of microparticles in
nonhomogeneous structures under uniaxial deformations**

field of higher education: 5. Technical sciences; professional field: 5.2. Electrical engineering,
electronics and automation; scientific specialty: Elements and devices for automation and
computing technology

Member of the scientific jury: **Prof. Dr. Dimo Georgiev Stoilov (TU - Sofia, INRNE - BAS)**

1. General characteristics of the dissertation work

The dissertation is 114 pages long. It contains an introduction, five chapters, a conclusion, a statement of claims for contributions, a list of references and a list of publications related to the dissertation. The work contains a total of 68 figures and 3 tables, as well as other illustrations. The presented list of dissertation publications contains 3 articles and three inventions made in the process of developing the dissertation. The articles are in proceedings of prestigious scientific conferences. In two of them the candidate is the sole author, and the third is co-authored with the scientific supervisor. The bibliography includes 71 sources, 42 of which are in Latin and the remaining 29 are in Cyrillic. Proves for candidate's participation in the implementation of two significant projects - European and national - are presented. Results of the work on the dissertation were reported to the most authoritative academic forum in the country (Assembly of Academicians and Corresponding Members) and were included in the BAS report for 2022, presented to the National Parliament. No citation data is provided for the dissertation publications.

I find that the presented materials fully comply with the legal requirements regarding the acquisition of the scientific and educational degree "Doctor", contained in the Law for development of the academic staff in the Republic of Bulgaria, rules for its application, rules in BAS and the internal rules of the IR - BAS.

2. Relevance of the problem considered in the dissertation work in scientific and applied science aspects

The problem developed in the dissertation is relevant and important. It refers to the improvement of existing and the creation of new sensor methods and technologies for diagnostics and control of the condition of rock formations and concrete composites. The idea of the dissertation is to propose an innovative integral method for assessing the stress state of these non-uniform structures by studying the observed effect of particle emissions from the surface of nonhomogeneous rock systems from the territory of the country. It is shown that the quantity and characteristics of the microfractions released during uniaxial deformation can

serve as an indicator of the internal stresses, the accumulated potential energy and the structural integrity of the rock massifs. Through the emission of these micro- and nano-sized particles, the possibility of early warning and prevention of impending destruction in critical infrastructure is revealed.

As a result of the critical review of the literary sources, the purpose of the dissertation, the tasks to be solved and the activities related to them were formulated. They have been fully performed and the set goal has been achieved. I draw attention to the two tasks determining a significant economic and social effect, scientific and applied novelty: a) establishing the functional relationship and dependencies between the emission of particles, the level of deformation of rock structures, and additional factors, b) design and implementation of innovative engineering solutions for obtaining integral information about the state of rock systems.

3. Correspondence of the chosen research methodology to the set goal and tasks of the dissertation work

The chosen research methodology is appropriate and adequate to the set goal and the tasks to be solved: a) the existing methods for evaluating and monitoring the stressed-deformation state of the rock massifs are analyzed with a focus on various mechanisms for interpreting stresses and deformations in nonhomogeneous systems; b) laboratory equipment was used for uniaxial deformation of rock structures, which allows direct observation of the processes that develop in the samples under pressure, including the formation of finely dispersed mineral particles from their surface, and this approach enabled high-precision emissions measurement of finely dispersed particles simultaneously in different size ranges; c) experimental studies of the processes of deformation and destruction of sample bodies from rock formations were carried out and the results were thoroughly analyzed. This methodical sequence allowed the achievement of the goal: clarifying the mechanisms of destruction of rocks and other nonhomogeneous structures under uniaxial deformations.

4. Contributions of the dissertation work

In the general description, placed at the beginning of the dissertation, the candidate has correctly described the contributing activities that he personally performed. They show a well-planned, systematic research process that ended up achieving the set goal. The received scientific and applied science contributions relate to observation and researched new scientific problem in the field of sensors. I accept the formulated claims, finding it appropriate to combine the third and fourth contributions, because the effect of deformation pressure on rock structures to the limits of their disintegration represents an extreme manifestation of the researched functional dependence. As I indicated in the previous point, apart from scientific and applied novelty, the contributions suggest a significant economic and social effect. They are the candidate's personal merit, and were achieved under the scientific and methodical guidance of the well-known scientist in the subject area of the dissertation, Prof. Dr. Siya Lozanova and in collaboration with the renowned scientist academician Chavdar Roumenin.

5. Remarks, opinions and recommendations

I have no significant remarks on the candidate's work. Noticed typographical errors and minor stylistic inaccuracies do not spoil the impression of the qualitatively performed and appropriately presented research work. I recommend the candidate to continue and deepen his work in the field of sensors and to publish his results in impact factor/ranked journals.

The abstract is prepared according to the requirements in IR - BAS. It gives a complete and objective view on the structure, content and contributions of the dissertation work.

6. Conclusion

The materials submitted by the candidate convincingly demonstrate compliance with the legal requirements of the LDASRB, RALDASRB, rules in the BAS and the internal rules of the IR - BAS regarding the acquisition of the scientific and educational degree "Doctor" in the field of higher education "5. Technical sciences", professional field "5.2. Electrical engineering, electronics and automation", scientific specialty "Elements and devices for automation and computing technology". The dissertation contains the necessary scientific and applied contributions. The candidate has demonstrated in-depth theoretical knowledge and developed research skills that characterize him as an energetic and promising young scientist.

Therefore, I give a positive assessment and strongly recommend to the honorable Scientific Jury to award M.Sc. Eng. Martin Lachezarov Ralchev the educational and scientific degree "Doctor" in the specified scientific field and specialty.

Date: 10.06.2024

MEMBER OF THE JURY:

/prof. Dr. Dimo Stoilov/