STATEMENT

by Prof. Gueorgui Penev Vassilev, DSc, University of Plovdiv

member of the academic jury convened to render a decision on the conferral of the educational and scientific degree "doctor" (PhD) to Katya Petrova Hristova, in accordance with the Classifier of the areas of higher education 4. Natural sciences, mathematics and informatics, professional field 4.2. Chemical sciences (Technology of the Inorganic Substances)

1. General presentation of the procedure and the doctoral student

The author of the dissertation is Katya Petrova Hristova - a doctoral student in part-time study at the Department of Chemical Technology, with scientific supervisor Assoc. Prof. Dr. Dancho Tonchev Tonchev, retired.

The set of materials presented by Katya Hristova is in accordance with Art. 36 (1) of the Regulations for the Development of the Academic Staff of the University of Plovdiv, includes the following documents:

a request to the Rector of the University of Plovdiv for the disclosure of a procedure for the defense of a dissertation; a curriculum vitae in European format; protocol No. 18 (02.04.2025) of the extended departmental council, related to reporting on the opening of the procedure and preliminary discussion of the dissertation; dissertation; abstract; list of scientific publications on the topic of the dissertation (five issues); copies of scientific publications; declaration of originality and authenticity of the attached documents; certificate of compliance with the minimum national requirements.

Katya Hristova obtained (at the University of Plovdiv) bachelor's degrees "Chemist - Medical Chemistry" and "Teacher of Chemistry and Environmental Protection" - both in 2019, and a master's degree in "Chemist - Food Chemistry" in 2020, at the same university. Since 2021, she has been enrolled as a full-time doctoral student at the Paisii Hilendarski University, and before the end of the three-year period of study, she has been transferred to part-time doctoral studies.

2. Relevance of the topic

Luminescent inorganic materials have the potential for application in security elements (i.e. protection against counterfeiting of personal documents) due to the possibilities for modeling the necessary properties. Many laboratories around the world are working on the topic of synthesis and research of luminescent crystalline substances, which is the topic of the presented dissertation work. Knowledge of correlations between synthesis conditions and optical characteristics, structure and thermal, chemical and mechanical properties of materials can allow development of the potential for practical application

3. Knowledge of the problem

The dissertation contains 180 pages. A description of the state of the problem (the so-called Literature Survey) takes up pages 6 to 57. Chemical and physicochemical properties of borates (in particular yttrium, lanthanum and aluminum ones) are described, as well as methods for synthesis

and doping of these compounds. Particular attention is paid to luminescence, which is a key phenomenon for the topic of the presented dissertation. Knowledge of the state of the problem is shown, and the literary material is meaningful and related to the tasks of the dissertation.

4. Research Methodology

For the purpose of the research, the necessary materials were synthesized using two different methods, after which the corresponding samples were subjected to various studies. The main emphasis was placed on the luminescent properties of the samples. From the above, it is clear that the chosen and implemented methodology is adequate to the tasks specified as the goal of the dissertation work.

5. Characteristics and assessment of the dissertation work and contributions

The dissertation work is divided into seven chapters, indicated by Roman numerals. The literature review (Chapter I) is discussed in point 3 of this opinion. The next two chapters describe, respectively, the goals and objectives (Chapter II), as well as the materials and method used (Chapter III). The majority of the work (pp. 65 – 145) is devoted to the results and their discussion (Chapter IV). YBO3:Eu and YBO3:Eu:Ce were experimentally synthesized, with special attention paid to the structural changes in these materials with an increase of boric acid percentage in the reaction mixture (Sections IV.1 – IV.3).

For the first time, it was established that the optimal boric acid excess for the sake of maximum luminescence intensity samples synthesis, at a wavelength of ~612 nm, is 45%. Lanthanum borates (LaBO3:PE = Eu, Tb, Dy, Gd, Ce) (Section IV.4) and aluminum borates (AlBO3:PE = Eu, Tb, Dy, Gd, Ce) (Section IV.5) were synthesized and studied using similar methods.

Sections IV.6 and IV.7, respectively, are devoted to Fluorescence analysis of lanthanum and aluminum borates and to Measurement of luminescence of materials using a smartphone. Chapter V (pp. 140 – 149) is final and summarizes the results and contributions of this dissertation work. In addition to the contribution regarding the effect of excess boric acid (noted above), it is shown that microwave-assisted synthesis of yttrium borates doped with europium can be carried out in a series with increasing excess boric acid (from 5 to 60%).

Novel data obtained on the chemical resistance of yttrium, aluminum and lanthanum borates, established general patterns of luminescence of alloying components and the synergistic effect when co-alloying several components in one matrix, as well as measurement of fluorescent materials using a smart phone camera can be regarded as scientific and applied results. Overall, the results obtained are promising for industrial developments.

6. Assessment of the publications and personal contribution of the doctoral student

Five scientific publications are presented, in which K. Hristova is a co-author. In three of them she is in first place of the respective team. These works are related to the topic of the presented dissertation work and satisfy the minimum national requirements for acquiring the educational and scientific degree "doctor". I am convinced that the contribution of the doctoral student in carrying out the experiments, processing and interpreting the results, and shaping the works is significant and she deservedly has the right to use them. There is interest shown in these publications by other researchers, which is expressed in the presence of five citations.

7. Abstract

The abstract consists of 32 pages and its structure follows (in general) that of the thesis. It reflects, in an appropriate manner, the main methods and results of the research. Some reasonable recommendations for continuing and expanding the topic are also proposed, which I support.

CONCLUSION

The dissertation contains scientific, scientifically applied and applied results that represent an original contribution to science and meet all the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), the Regulations for the Implementation of ZRASRB and the relevant Regulations of the University "Paisiy Hilendarski". The dissertation shows that the doctoral student Katya Hristova possesses in-depth theoretical knowledge and professional skills in the scientific specialty 4. Natural Sciences, Mathematics and Informatics; professional field 4.2. Chemical Sciences by demonstrating qualities and skills for independent conduct of scientific research.

Due to the above, I confidently give my positive assessment of the conducted research, presented by the above-reviewed dissertation, abstract, achieved results and contributions, and I propose to the esteemed scientific jury to award the educational and scientific degree "doctor" to Katya Petrova Hristova in the field of higher education: 4. Natural Sciences, Mathematics and Informatics; professional field 4.2. Chemical Sciences; doctoral program: Technology of Inorganic Substances.

29.05.2025 Signatute:

Prof. DSc G.P. Vassilev