# STATEMENT

### by Dr. Dimitar Nikolaev Petrov,

# Associate Professor at the Department of Physical Chemistry, Faculty of Chemistry, Plovdiv University "Paisii Hilendarski"

of a dissertation for the award of the educational and scientific degree "doctor"

by: field of higher education 4. Natural sciences, mathematics and informatics;

professional field 4.2. Chemical Sciences;

doctoral program Technology of inorganic substances.

Author : Katya Petrova Hristova

**Topic**: "Synthesis and study of yttrium, lanthanum and aluminum borates doped with rare earth compounds"

Scientific advisor : Assoc. Prof. Dancho Tonchev Tonchev, PhD.

#### 1. General presentation of the procedure and the doctoral student

By order No. RD – 22 – 909 of 22.04.2025 of the Rector of the Plovdiv University "Paisii Hilendarski", I have been appointed as a member of the scientific jury for ensuring a procedure for the defense of a dissertation on the topic "Synthesis and study of yttrium, lanthanum and aluminum borates doped with rare earth compounds" for the acquisition of the educational and scientific degree "doctor" (PhD) in field of higher education 4. Natural sciences, mathematics and informatics; professional field 4.2. Chemical Sciences; doctoral program *Technology of inorganic substances*. The author of the dissertation is Katya Petrova Hristova - a doctoral student in part-time study at the department "Chemical Technology" with scientific supervisor Dr. Dancho Tonchev Tonchev, Associate Professor from Plovdiv University "Paisii Hilendarski", Faculty of Chemistry, Department of Chemical Technology, retired.

In 2019, Katya Hristova graduated from the PU "Paisii Hilendarski" with a bachelor's degree in "Medical Chemistry" and "Teacher of Chemistry and Environmental Protection", and in 2020 she also acquired a "master" degree in "Food Chemistry". Katya Hristova was enrolled as a full-time doctoral student at the Department of Chemical Technology on 01.03.2021, and on 01.03.2024 she switched to part-time study. She was enrolled with the right to defend her thesis in 2025.

The set of materials submitted by the candidate on paper **is** in accordance with Art. 36 (1) of the Regulations for the Development of the Academic Staff of the Plovdiv University and includes the following documents:

a request to the Rector of the Plovdiv University to disclose the procedure for defending a dissertation;

- ➢ CV in European format;
- minutes from the department council, related to reporting the readiness to open the procedure and preliminary discussion of the dissertation work;
- ➢ dissertation;
- abstract in Bulgarian and English;
- > a list of scientific publications on the topic of the dissertation;
- copies of scientific publications;
- list of noted citations;
- declaration of originality and authenticity of the attached documents;
- a certificate of compliance with the minimum national requirements for acquiring the PhD. degree;
- > opinion of the scientific supervisor regarding the dissertation work.

# 2. Relevance of the topic

Lanthanides and their crystalline compounds have extremely important applications in many areas. They are mainly used in electronics and optics as sensors, LEDs, chips, solid-state lasers (YAG), phosphors, optical memories, high-temperature superconductors, catalysts, etc. It is evident that lanthanides are the basis of the so-called "high technologies". In recent years, the interest in yttrium, lanthanum and aluminum borates doped with various lanthanides or their compounds such as oxides and fluorides has been growing exponentially, precisely because of their valuable optical properties and applications. 5 citations of the articles on the dissertation have also been noted, which in itself proves the significance and relevance of the problem set in the dissertation. For these reasons, I believe that the topic and tasks of this dissertation are relevant both in a purely scientific and in an applied aspect.

# 3. Knowledge of the problem

The dissertation cites 273 literature sources, all from international refereed and indexed journals with an impact factor. The literature review is complete, and the goals and objectives are defined clearly and precisely. This is a sufficient indicator of the high level of knowledge of the dissertation's issues.

# 4. Research methodology

The research methods are modern and allow achieving the set goals and solving the tasks set in the dissertation. They include: X-ray diffraction (XRD), Fourier transform infrared spectroscopy, Raman and photoluminescence spectroscopy, Fluorescence analysis, Determination of the chemical stability of the studied compounds.

# 5. Characterization and evaluation of the dissertation work and contributions

The dissertation contains 181 pages, of which 150 pages are main text, 107 figures, 17 tables, 5 schemes, 5 photos and 273 literary sources. The dissertation thesis has both purely scientific and applied contributions. The maximum excess of boric acid for achieving maximum fluorescence

efficiency has been established, a detailed comparative analysis of yttrium borate, obtained by two different methods – solid state and microwave-assisted synthesis, and fundamental conclusions have been drawn about the changes in optical and chemical properties. The chemical stability of yttrium, aluminum and lanthanum borates has also been evaluated, which provides valuable information for relevant practical applications. For the first time, measurement of fluorescent materials using a smartphone camera is presented. The potential for contactless, fast and reliable measurement of luminescent materials have been investigated in the present dissertation.

### 6. Assessment of the doctoral student's publications and personal contribution

The doctoral student has submitted 5 publications on the topic of the dissertation, of which one publication in a journal with a quartile Q1, two publications in journals with quartile Q2, one publication in a journal with quartile Q4 and one publication in a journal without a quartile. A list of the doctoral student's participation in 6 scientific conferences is also presented, of which two are international conferences, one with international participation and three are national. The participations are in the form of three reports and three posters.

It is necessary to mention that in 4 out of a total of 5 submitted publications, the PhD candidate is the first author, which unequivocally shows the personal merit of the PhD student in the research, writing and publication of the mentioned articles.

#### 7. Abstract

The abstract meets the requirements and reflects the main results achieved in the dissertation.

#### 8. Recommendations for future use of the dissertation contributions and results

SEM and TEM studies should be carried out in order to check the morphology of the obtained materials, the degree of agglomeration, the type and shape of the particles. The size of the particles also needs to be calculated. In addition, it would be possible to conduct a theoretical analysis of the obtained results according to the Judd – Ofelt theory and to calculate the intensity parameters  $\Omega_2$ ,  $\Omega_4$  and  $\Omega_6$ .

#### CONCLUSION

This dissertation *contains scientific and applied scientific results that represent an original contribution to science* and **meet all** the requirements of the Act on the Development of the Academic Staff in the Republic of Bulgaria (ADSRB), the Regulations for the Implementation of the ADSRB and the relevant Regulations of the Plovdiv University "Paisii Hilendarski".

The dissertation shows that doctoral student Katya Petrova Hristova **possesses** in-depth theoretical knowledge and professional skills in the indicated scientific field, **demonstrating** qualities and skills for independently conducting scientific research.

Because of the above, I confidently give my **positive opinion assessment** of the research conducted, 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"* of 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".

20.05.2025

Prepared the opinion : .....

(signature)

Assoc. Prof. Dimitar Petrov, PhD