REVIEW

on a competition for the academic position of “associate professor” in professional field 4.1. Physical Sciences, specialty “Condensed Matter Physics”, (Development of technologies and devices for applications in sensorics and photonics) announced by the Central laboratory of Applied Physics at the Bulgarian Academy of Sciences, Plovdiv, in the State Gazette, issue 55 of July 8, 2025 with candidate: Senior Asst. Prof. Dr. Hristo Todorov Kisov from the Sentral laboratory of Applied Physics at the Bulgarian Academy of Sciences, Plovdiv

Reviewer: Prof. Evgeniya Petrova Valcheva, Sofia University "St. Kliment Ohridski", Faculty of Physics

1. General description of the submitted materials

In the competition for the academic position of "associate professor", the only candidate is Dr. Hristo Todorov Kisov. The materials submitted by the candidate for the competition include all documents required by the Law on the Development of the Academic Staff of the Republic of Bulgaria and the Regulations on the Development of the Academic Staff of BAS. The candidate participates in the competition with a total of 28 scientific publications in refereed international journals, 9 of which are from the habilitation work to indicator B4 and 19 to indicator D7. Publications used in the doctoral dissertation are not included. The publications that the candidate presents for the competition for the academic position of "associate professor" were published in the period 2013–2025. The habilitation work (to indicator B4) includes 3 publications with categories Q1, 2 publications with Q2, 2 with Q3 and 2 with SJR. The publications for indicator G7 outside the habilitation thesis are 19 in total. All are in refereed international journals, including 5 publications in category Q1, 1 each in categories Q2, Q3 and Q4, 10 publications in journals with impact rank and one in other refereed journals.

For indicator D11, the number of citation points indicated is 78. For indicator E 13-15 (participation in national and international projects and supervision of a doctoral student), the number of citation points indicated is 140. Doctor Kissov holds two patents (utility model) and one patent application. A list of participations in conferences without indexing is attached. The candidate has participated in the teams of 4 national scientific projects, one of international cooperation and the leader of one project under the Competition for Funding Scientific Research of Young Scientists and Postdoctoral Students - 2017. From the materials and scientometric data presented by the candidate Dr. Kissov, with which he applies for the academic position of "associate professor", after taking into account the above features, I accept for review the following scientometric data:

- Indicator A: Dissertation for awarding the ONS "doctor" - 50 points
- Indicator B 4: Habilitation thesis/publications -165 points
- Indicator D (from 5 to 10) - 343 points
- Indicator D 11 - 78 points,
- Indicator E - 140 points.

2. Publications before and after receiving the scientific degree.

In 2013, a dissertation for the scientific degree of Doctor of Quantum and Optoelectronics was defended (2.20.05) at the Department of Laser Technology and Electronics, Technical University of Sofia, Plovdiv Branch with the topic "Development of solid-state quantum generators based on Neodymium-YAG media with uncompetitive simultaneous generation of a pair of lines and frequencies in the range of 1-1.4 microns". The materials presented here by Dr. Kisov and the scientometric indicators analyzed above do not repeat the scientific results and publications included in the doctoral dissertation. The number of points on the indicators meets, and even significantly exceeds, the national minimum requirements for holding the academic position of "associate professor", set out in the Law on the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB) and the regulations for its implementation. All publications under consideration were published after receiving the scientific degree of Doctor.

3. General characteristics of the candidate's scientific, scientific-applied and pedagogical activities

The candidate's scientific and scientific-applied activities are significant. They fall into the scientific-applied field of "Development of devices and technologies for applications in photonics and sensorics". In particular, Dr. Kisov's contributions are mainly in the development of new active laser media; creation of an experimental high-vacuum system for assisted pulsed laser evaporation and obtaining thin layers of biological materials; creation and research of various sensors. Dr. Kisov graduated as a physicist (a diploma for completed higher education equivalent to a master's degree) from the "Paisiy Hilendarski" University, Plovdiv, specializing in Laser Technology and Technology in 1996. He obtained a PhD at the Technical University of Sofia, Plovdiv Branch, scientific field: Electrical Engineering, Electronics and Automation, in the Doctoral Program: Quantum and Optoelectronics (also included in physical sciences - according to the classifier) in 2013 with a dissertation on the topic "Development of solid-state quantum generators based on Neodymium-YAG media with uncompetitive simultaneous generation of a pair of lines and frequencies in the range of 1-1.4 microns". The candidate was a fellow under the ERASMUS program for the academic year 2009-2010 for a period of 3 months at the Technical University of Prague, Czech Republic. He successively held various positions as an assistant and Senior Assistant Professor at the Institute of Optical Materials and Technologies (IOMT), Acad. Y. Malinovski", BAS, Laboratory "Composite and Nanostructured Optical Materials"; Senior Assistant Professor at the Central Laboratory of Applied Physics (CLAPF) - Bulgarian Academy of Sciences, Plovdiv, etc. Dr. Kisov has significant pedagogical experience. As a part-time assistant at the Plovdiv University "Paisii Hilendarski", he lectures on "Laser Technique" and lectures and laboratory exercises on "Measurement of Laser Parameters", as well as Laboratory exercises on "Optical Communications". As a part-time assistant at the Agricultural University, Plovdiv, he leads laboratory exercises on General Physics. Additionally, he has participated as a thesis supervisor of 9 successfully defended graduates at the Technical University – Sofia, Plovdiv Branch, Faculty of Electronics and Automation, Department of Quantum and Optoelectronics, and

currently of one at the Plovdiv University “Paisii Hilendarski”, Faculty of Physics and 2 Technology, Department of Physics. As a part-time assistant at the Technical University, Sofia – Plovdiv Branch, he leads Laboratory exercises on Optoelectronic and Laser Devices in Medicine (OELUM); Laboratory exercises on Laser Technique and Optoelectronic Devices and Seminar exercises on General Physics.

4. Main scientific and applied scientific contributions

The scientific topic of Dr. Kisov's research is significant and relevant. The main contributions of the topic developed by the candidate in the publications with which he participates in the competition are proving with new means significant new aspects of already existing scientific fields, problems, obtaining and proving new facts; application of scientific achievements in practice. In general, the results obtained are both fundamentally significant and contain potential for application. The presented contributions to the habilitation work are grouped into 2 topics, which are divided by studied materials, technologies, structures and devices, as follows:

1. *Development and research of laser media for cavityless lasers – works B1 – B7*

Specifically, research in the field of cavityless lasers has been conducted in this direction and is reflected in publications B1 – B4. An active laser medium has been obtained, which consists of a solid matrix of epoxy resin (Bisphenol A) with a hardener (Diethylenetriamine), in which a pair of organic dyes – Rhodamine 6G and Rhodamine B – are incorporated in certain ratios. Radiation with a fluorescence spectral width of more than 100 nm has been obtained (B1,B2). The fluorescence and generation spectra of the obtained composite material have been studied (B1,B2). The surface structure and its topography (B3) of the studied medium have been studied with modern high-precision methods.

The results of the conducted research can be summarized as follows:

1. A solid-state, self-nanostructured medium with very good optical properties (optically transparent for almost the entire visible spectral region) was obtained, which has a large internal light scattering.
2. Simultaneous excitation of both dyes with the same wavelength, for example – 532 nm (SHG, Nd:YAG laser with a pulse duration of 10 ns), was obtained.
3. A wide fluorescence spectrum was obtained.
4. Four-wave mixing of frequencies was obtained in this composite organic medium. Such a result from a similar material under nanosecond optical excitation was obtained for the first time.

In three publications together with an international group (B4, B5, B6) the following contributions have been achieved. Work (B5) is focused on the development and investigation of an active laser medium based on the pair of organic dyes Rhodamine 640 and Methylene Blue at different molecular ratios of the donor – acceptor system. Their influence on the resonant energy transfer (Förster Resonance Energy Transfer) has been studied, as well as the influence of the presence of silver nanowires in the medium on the spectrum and intensity of its emission. The results show that resonator-free (random) laser emission with a wavelength exceeding 700 nm has been achieved.

Work (B6) is familiar with the development, preparation and investigation of an active laser medium without a kitchen (Au + Rhodanine B + pvp (Polyvinylpyrrolidone) + AgNWs), which is however set to work in the kitchen with a special architecture. For this purpose, a special triple cavity has been developed. The characteristics of a dye laser (LDS 821) with gold nanorods (NRs) (B7) as scattering centers were investigated to better understand how random lasers work in the near-infrared (NIR) region. The study presents the results using Au NRs with different sizes (22.3 nm × 7.2 nm and 18.8 nm × 6.3 nm) and different concentrations (1 and 2 × 1018 cm−3). Dye laser emission was achieved using both sizes of Au NRs and at both concentrations. The direction of developing cavityless (arbitrary) lasers is new for Bulgaria and the group is the first with this topic.

2. Development and optimization of laser technologies for the deposition of thin nanometric layers of biological materials under vacuum – works B8 – B9.

The first vacuum system was created at IOMT-BAS, which works with assisted pulsed laser evaporation of biological substances on diffraction gratings – the so-called MAPLE technology (Matrix-Assisted Pulsed Laser Evaporation) for the transport and deposition of delicate highly sensitive molecules. The possibility of direct immobilization using the MAPLE technology was proven, while preserving the bioactivity of the deposited substances. For the first time, layers of Hb were deposited using this technology. The bioactivity of the individual functional groups of the deposited Hb layer was proven and ultra-sensitive glucose detection was achieved by surface plasmon resonance (SPR) (B8). A technology for modified pulsed laser deposition of biological layers has been developed, and the correlation between the parameters of the laser radiation, the temperature of the target and the parameters in the vacuum chamber has been established. As a result, a highly efficient biosensor has been obtained, the performance of which has been proven through the interaction of Hb with glucose (glycated hemoglobin). Structures including cholesteric layers (CL) and a metal lattice for SPR have been studied theoretically and experimentally (B9), with a focus on different modes of propagation of normal modes in the cholesteric liquid crystal layer. Structures including cholesteric layers (CL) and a metal lattice for SPR have been studied theoretically and experimentally (B9), with a focus on different modes of propagation of normal modes in the cholesteric liquid crystal layer. The data and analysis are valuable for researchers interested in the application of MAPLE techniques for immobilization of metalloproteins, as it provides a unique opportunity for direct immobilization.

Scientific contributions outside the habilitation work of Dr. Kisov are in the following areas (G1-G19):

1. Development and optimization of laser technologies for the deposition of thin nanometric layers under vacuum from biological materials (as a continuation of the habilitation work).
2. Experimental and theoretical study of the penetration of laser radiation into opaque tissues and determination of the absorbed and scattered part of the energy falling on these tissues (in this case, dental tissues).
3. Study of the disperse composition of model emulsions containing biopolymer.

5. Reflection of the candidate's scientific publications in our and foreign literature (according to his data)

The candidate participated in the competition with 28 publications, of which 27 had an impact factor or impact rank (Scopus). The number of citations is significant (over 70 according to Scopus), which is an indication of the significance of the topics being developed and the published results. In a large number of them, he is the lead author. The candidate's H-index is 4 (according to Scopus).

6. In the case of collective publications, the candidate's contribution should be separated, and in the case of a plagiarism signal, an opinion should be given on the presence or absence of plagiarism (ZRAS RB, Art. 10 (2)).

All publications by Dr. Kisov are co-authored. In 5 publications from the habilitation thesis he is the first author, in category D – in 2 publications. Declarations of contribution and co-authorship are presented, in which the candidate's contribution to the general publications is correctly clarified. Therefore, I consider the candidate's contribution to be substantial. There is no evidence of plagiarism.

7.Critical comments of the reviewer on the submitted works, including on the candidate's literary awareness.

I have no critical comments on the submitted works and I do not question the achievements and contributions of the candidate.

8. Personal impressions of the reviewer about the candidate and other data not specified in the previous points.

My personal impressions of the candidate, as well as the submitted materials for the competition, convincingly demonstrate his high scientific qualification and competence in a wide range of scientific problems of both fundamental and applied nature in the field of condensed matter physics.

9. Motivated and clearly formulated conclusion.

Dr. Kisov's scientometric indicators fully satisfy and even exceed the requirements for holding the academic position of "associate professor", set out in the Law on the Development of the Academic Staff in the Republic of Bulgaria (LAADRB) and the regulations on the terms and conditions for acquiring scientific degrees and holding academic positions of the Bulgarian Academy of Sciences. With full conviction, I recommend to the esteemed Scientific Jury to support and propose to the Scientific Assembly that Dr. Kisov be elected to the academic position of "associate professor" in professional field 4.1. Physical Sciences.

Date 11.10.2025

Reviewer:

/signature/