REVIEW

On the Contest for the Occupation of the Academic Position "Professor"

announced by ISSF-BAS for the needs of the Central Laboratory of Applied Physics (CLAP)-BAS, Plovdiv in State Gazette #21 of 15.03.2022 in professional direction 4.1. "Physical Sciences" scientific specialty "Physics of Condensed Matter" (Wave Processes).

Candidate: Assoc. DSc Tinko Aleksandrov Eftimov, CLAP-BAS

Reviewer: Prof. PhD Georgi Lalev Dyankov, Institute of Optical Materials and Technologies – BAS.

I. General description of the submitted materials

1. Data on the submitted documents

Following the requirements of the procedure, the applicant submitted:

1. Copies of 32 articles, of one monograph, of 4 chapters of collective monographs and of one patent;

2. Summaries of these articles in Bulgarian and English

- Lists of indicators B-E according to the Regulations for the implementation of LPAS RB, which include: scientific papers - 37, citations - 148, supervision of two PhD students; participation in 4 national scientific/educational projects; management of 2 scientific/educational projects; participation in one international scientific/educational project.

3. Summary of project funds managed by the applicant.

4. Complete list of publication citations, examples of significant citations;

5. Table #3 certifying that the minimum national requirements according to the Rules LPAS RB, in accordance of LPAS-BAN and ISSP-BAS are fulfilled;

6. Documents for participation in projects, contracts, training of students, graduates students, PhD students, etc.

7. Certificates of substantial contribution of the applicant.

All publications presented by the candidate are after the defense of PhD thesis and the competition for "associate professor" and are not included in the NACID database.

2. General description of the scientific achievements of the candidate

The candidate's scientific activity is in the field of wave phenomena in optical fibers with applications to sensors and networks for engineering applications, as well as in the field of luminescence studies of solids and liquids, including studies of glasses, crystals and liquids for engineering applications, and also fluorescent analysis of food products for the purpose of qualitative characterization.

The nature of the scientific activity, based on theoretical research of a fundamental nature, which is transformed into applied research and its implementation in devices working in real engineering systems, is very impressive. The complex nature of this type of research requires in-depth knowledge and skills reflecting the complexity of the objects under the study. This challenge, perhaps, is the impetus for the hard work over the years, some of which I have witnessed. The candidate's scientific activity shows consistent, purposeful and systematic scientific growth over the past years. This is the result of his long-term work in Finland and Canada, but also of his ambition and activity in formulating new scientific tasks and in the ability to organize their implementation. This activity with a wide scientific range determines the significant scientific achievements, some of which were deservedly appreciated by the awarding of the scientific degree "Doctor of Physical Sciences" in 2010. It is logical that this accumulation of knowledge and experience should be shared and developed: the candidate was the supervisor of two PhD students, of more than 40 bachelor's theses, of more than 8 master's theses, head of two national scientific projects.

Along with scientific activity, the candidate possesses high pedagogical activity. As a lecturer at the University of Quebec, he gave lectures on mathematics, physics and engineering sciences to bachelors, on optics to masters; as a professor at Plovdiv University, he gave lectures on general physics, fiber optics, optical sensors and their application in biology and medicine, fiber-optic communications, etc. As an illustration of Tinko Eftimov's broad scientific range, I would like to point out the "Iconophysics" course taught by him, which is unique for Bulgaria.

3. Basic scientific and scientific-applied contributions

Habilitation thesis

The problems that are the subject of consideration within this procedure are from the field of wave phenomena in fiber optic structures. The object of theoretical and experimental research are 4 structures:

- Core Cladding Intermodal Interferometers (CCIMI – Core Cladding Intermodal Interferometer);

- long period gratings – LPG;

- fiber-optic Mach-Zehnder micro-interferometers (μIMZI – micro In-Fiber Mach-Zehnder Interferometer);

- low finesse fiber-optic Fabry-Perot micro-interferometers.

The first two are specific fiber optic structures with no analog in volume optics, while the second two have. Their fabrication, which is one of the contributions of the candidate, and in the both cases is based on an excellent knowledge of the physical nature of the phenomena, on the mastery of the mathematical methods for description and also on its implementation through technical means of fabrication. All this leads to the fabrication of these **unique devices** which makes famous the scientific group of which the candidate is a member.

With these **new appliance**, record detection sensitivities have been achieved. A point interferometer with a volume of tens of picoliters has been demonstrated for the first time. These results refer to the third structure and are reported in a series of 4 papers with quartile Q1 and Q2.

A comparative analysis of the behavior and field of application of the second and fourth of the studied structures was carried out. **New facts** have been obtained regarding the possibilities of increasing the LPG sensitivity to the refractive index by depositing nanolayers with a high refractive index (diamond-like carbon and silicon nitride). These results were published in 5 papers, 4 of which with quartile Q1 and one with quartile Q2.

New facts are obtained regarding the sensitivity of non-uniform long-period gratings to temperature gradients, and the possibility of measuring the mean temperature, the temperature gradient and its sign simultaneously using a single non-uniform LPG as a result theoretically simulations. Results were reported in three papers (Q1 quartile) and one conference paper.

As **new experimental facts** can be accepted the results for measuring temperature, temperature gradients, bending by long-period gratings and intermode interferometers.

The **applied activity** of the candidate is very active. The investigated fiber-optical structures are implemented in **unique devices**, finding application in various engineering fields:

- a combined spectrally multiplexed sensor-communication system with protection against unwanted intrusion to the optical cable, in which access to LPG structurs is in the communication range 1525 nm -1585 nm, information transfer up to 100 MB/s is at 1310 nm, and monitoring of unwanted access to the optical fiber is in low-mode at 650 nm along an optical cable up to 10 km long; Results were reported in 8 papers: two in Q1 and Q2 quartile journals and 6 conference papers.

- a system with photonic power supply of a sensor network and simultaneous transmission of information up to 1 MB/s along the same optical fiber for the purpose of applications in environments where the use of electrical cables for electrical supply is unacceptable and undesirable. Results were reported in 4 papers: two with Q4 quartile and two conference papers;

- a passive fiber-optic hydrophone sensor network based on a low finesse fiber-optic Fabry-Perot interferometer for the detection of acoustic waves in water environments; has patent protection since 2020.

The publications presented *outside the habilitation thesis* are entirely experimental and confirm the candidate's deep interest in scientific and applied activity, as well as the precise approach for solving each experimental task. The publications present **new experimental facts** about:

- the time responses of the luminescence of strontium aluminates, showing that they follow a power law and/or logarithmic law quite accurately, and the time constants depend on the temperature and the excitation and emission wavelengths;

- Established temperature dependence of the time responses of strontium aluminates;

- The spectral responses of crystals and glasses with different composition have been established and the possibility of different applications of the synthesized glasses;

The results are published in 8 articles.

The listed experimental facts are implemented in **two new devices**:

- Time-coded gamma radiation sensor in samarium-doped oxyfluoride glasses

- Temperature sensor based on the phosphorescence time response of strontium aluminates.

The results are published in 5 articles

New optical component structures enabling fluorescence-based broad-spectrum generation have been proposed to create fiber-optically compatible broad-spectrum sources for fiber-optic sensors with spectral detection, which are the subject of publication in 5 papers.

The conducted research, due to its thorough systematic nature, allows **generalizing conclusions** to be made about the luminescent and fluorescent characteristics of the studied structures, which explains their successful implementation in devices and structures with engineering applications.

4. Summary of scientific achievements

(The indicators and quartiles cited below are defined in the Regulations for implementation of the LPAS RB, Professional Area 4.1, Tables 1 and 2)

Scientific indicators are proof of the significance of the achieved results:

Indicator B4 - habilitation work, 8 publications with quartile Q1, 4 publications with quartile Q2 and 4 publications with quartile Q4 are included, providing 328 points (with a minimum of 100 required). In 11 publications (all with quartile Q1 and Q2) of these total of 16 articles, Tinko Eftimov is first or corresponding author.

Indicator G5 includes a monograph that is not presented as the main habilitation thesis, in which the candidate is the second author (out of a total of two).

Indicator G7: 16 articles are presented: one with quartile Q1, 4 with quartile Q2, 2 with quartile Q3, and 9 with quartile Q4.

Indicator G8: published book chapter or collective monograph - 4 book chapters, all published by Springer, are presented.

Indicator G9 presents one patent registered in 2020. All these provides 331 points for indicator G (with a minimum of 220 required)

The publications with which the candidate applies for the competition for the academic position "professor" were published in the period 2010-2022. All scientific publications presented in indicators B4 and G7 were published after the defense of PhD degree and the competition for "associate professor" and are not included in the NACID database.

Indicator D presents a list of 148 independent citations, 29 of which are acknowledged as essential (296 points out of min. 200). The nature of the citations also indicates the significance of the published results – what is distinctive and valuable about the research is explicitly mentioned. No citations with a negative evaluation or expressed doubt about credibility were noticed.

In the case of collective publications, the contribution of the candidate is clearly defined through the respective declarations of the co-authors.

The candidate's h-factor is 13 (Scopus).

I have no critical remarks on the scientific activity of the candidate or on the quality and significance of the presented results and contributions.

My personal impressions date back to the defense of PhD thesis of Tinko Eftimov in 1988. Although after that fate sent us to different continents, I have always been interested in his successes and convinced myself of his high professionalism. Our closer cooperation began after 2010, which not only strengthened my opinion of him as an outstanding professional, but I saw a colleague with a sense of honor and dignity.

II. GENERAL CONCLUSION

The scientific publications presented by DSc. Tinko Aleksandrov Eftimov characterize him as a leading specialist in the field of the announced competition, with high qualifications and great international recognition. He is capable of generating new ideas and leading research at the highest scientific level in the field of wave phenomena. The academic performance of DSc Tinko Eftimov significantly exceeds the minimum national requirements for occupying the academic position of "professor" laid down in the LPAS RB and the related regulations of the BAS and ISSP-BAS. Based on the above, I express **my positive opinion and unhesitatingly support the candidacy** of DSc Tinko Aleksandrov Eftimov **for the academic position of "Professor"** in the Central Laboratory of Applied Physics at the BAS, professional direction 4.1. "Physical sciences", scientific specialty "Physics of condensed matter" (wave optics).

Date: 07.08.2022

Reviewer:

Prof. PhD G. Dyankov / signature /