

## REVIEW

for a competition for holding the academic position of „Associated Professor”  
in professional field 4.1. Physical sciences for Sofia University „St. Kliment Ohridski”,  
Faculty of Physics, according to the announcement in  
State Gazette no. 87 from October 19<sup>th</sup> 2021

The review was written by **Prof. Dr. Tsvetanka Krumova Babeva**, Institute of Optical Materials and Technologies - BAS, professional field 4.1 Physical Sciences, in her capacity as a member of the scientific jury of the competition according to order № RD-38-578 /09.12.2021 of the Rector of Sofia University.

**Dr. Neno Dimitrov Todorov**, Senior research assistant in Faculty of Physics, Sofia University "St. Kliment Ohridski "(SU) has applied in the competition. There are no other applicants in the competition.

### I. General Description of the application

#### 1. Description of presented documents

The documents submitted by the applicant **comply** with the requirements of ZRASRB, PPZRASRB and the Regulations on the terms and conditions for acquiring scientific degrees and holding academic positions at Sofia University "St. Kliment Ohridski "(PURPNSZADSU) (hereinafter referred to as the Regulations of Sofia University). The detailed description and comprehensible arrangement of the presented materials have made a very good impression and characterizes the applicant as an organized scientist with clear mind.

The applicant, Senior research assistant Dr. Neno Dimitrov Todorov, participated in the competition with 18 papers, none of which repeats the papers presented in previous competitions for Senior research assistant, nor those used in the acquisition of PhD degree. As an equivalent to habilitation work, four papers published in journals in the first quartile (Q1) have been presented.

The strong distribution of scientific papers by quartiles is an evidence of the importance of the results obtained: **9** of the papers were published in journals ranked in the first quartile, **Q1**-journals, (publications with numbers from 1 to 9 from list 10B), **3** in **Q2**-journals (publication from 10 to 12), and 3 are in journals with impact rang -SJR journals (publications numbered 13 to 15 from list 10B). Three of the presented works have been published in non-indexed journals. Although the these non-indexed papers do not carry points according to ZRASRB and the Regulations for its implementation, I accept them for review because they

demonstrate important activity of the applicant, namely his active work with students as head of the Bulgarian national team for international and European Olympiads, as well as an author of physical problems for national competitions and Olympiads.

In addition to a publication list, 17 other documents supporting the achievements of the applicant are submitted in the competition and described in details in his application letter. These include: curriculum vitae, diplomas of higher education and PhD degree, certificates for academic position and work experience, medical certificate, criminal record, list of all publications, conferences, projects and student supervision activities generated by the system "Authors" of Sofia University, list of citations, templated table for fulfilment of the minimum national requirements and the additional requirements of Sofia University, self-report for applicant's contributions, papers abstracts and a copy of the announcement in the State Gazette.

## 2. Applicant record

Dr. Neno Todorov graduated from Faculty of Physics of Sofia University in 2009 with Bachelor degree and in 2010 with Master degree. Very recently after his graduation he became a PhD student in Faculty of Physics of Sofia University while also studying at the Jean Ruxel Institute of Materials in Nantes, France. In 2014 he defended his PhD thesis titled "*Phonons in oxides with complex crystal structure*", under the supervision of Prof. M. Abrashev, DSc and acquired PhD degree in the professional field 4.1 Physical Sciences. During his study as a student and later as a PhD student he worked as a physicist and then as an assistant at the Faculty of Physics at Sofia University, where he maintained equipment and assisted in conducting seminars and student practice in mechanics, physics, molecular physics and biophysics. In 2019 he went on a short-term postdoctoral specialization (6 months) at the Free University of Berlin, where he specialized in the field of X-ray absorption spectroscopy of transition metal oxides in BESSY II Electron storage ring - Helmholtz-Zentrum Berlin (HZB). Since 2015, Dr. Neno Todorov has been working as a senior research assistant at the Faculty of Physics at Sofia University, delivering lectures, seminars and workshops.

Since 2009 he has participated in the working teams of **12 research projects** funded by Horizon 2020 (1), Bulgarian National Science Fund (5) and Science Fund of Sofia University (6). The applicant has supervised two theses of master's students from the Faculty of Physics at Sofia University. Also he was a member of the National Commission for Organizing and Conducting National Olympiads and Physics Competitions and was Head of the National Physics Team and the Physics Team of Sofia University.

### 3. General characteristics of publication and scientific achievements of the applicant

The publications and achievements of the applicant are in the professional field 4.1 Physical Sciences and fully correspond to the field in which the competition was announced. In particular, the research work of Dr. Todorov is in the field of Raman spectroscopy and includes optimization and conduction of measurements, analysis and identification of the obtained characteristic peaks in the spectra and theoretical calculations of the dynamics of the crystal lattice. Owing to the collaboration with various teams thus working with various objects, the applicant has gained rich and valuable experience in the field of vibrational spectroscopy.

The scientific record of the candidate fully **meet the minimum national requirements** (under Art. 2b, para. 2 and 3 of ZRASRB), as for group D these are exceeded many times:

**group A** - 50 points (out of at least 50 points) – PhD thesis

**group B** - 100 points (out of at least 100 points) - 4 publications in Q1-journals (from №1 to №4 of publication list 10B)

**group G** - 215 points (out of at least 200 points) – 5 publications in Q1-journal (from №5 to №9 of publication list 10B), 3 publications in Q2-journal (from №10 to №12 of publication list 10B) and 3 publications with SJR (from №13 to №15 of publication list 10B)

**group D** - 544 points (out of at least 100 points), collected from 272 citations

The scientific record of Dr. Neno Todorov **satisfies** and even exceeds the **additional requirements** to the applicants, set by the Faculty of Physics of Sofia University in professional field 4.1. Physical sciences. The following table describes the compliance:

Additional requirements	minimum value	applicant's value	Paper № from 10B list
Successful graduates (bachelor or master degree)	1	2	-
Number of Q1 and Q2 publications in the last 3 years (2019-2021)	1	4	3, 5, 6 and 10
Number of Q1 and Q2 publications	7	12	from 1 to 12
Number of Q1 and Q2 publications with significant applicant contribution	4	6	1, 2, 6, 7, 10 and 12
<i>h</i> -index	5	7	-
Teaching, hours	540	1890	-

The scientific papers presented by the applicant do not repeat those of the procedures for acquiring the PhD degree and the academic position "Senior research assistant". There is no legally proven plagiarism in the scientific papers submitted at the competition, nor are there any doubts of such.

#### 4. Description and assessment of teaching activity of the applicant

Dr. Todorov delivers lectures on "Fundamentals of Physics I", "General Physics", "Optics" and "Raman Spectroscopy", seminars on "Mechanics", "Electricity and Magnetism", "Optics" and "Probabilities and Physical Statistics" and workshops on "Mechanics", "Fundamentals of Physics I" and "Raman Spectroscopy". The number of teaching hours of the applicant for the last 5 years is impressive -1890 hours or 378 hours on average per year. In addition, the candidate has supervised the theses of two master students.

His active work with students is also very impressive. He has participated in the organization and conduction of 6 national physics competitions (from 2015 until now) and 4 spring and 4 autumn national physics competitions in the last four years. Dr. Todorov has been the head of the national physics team at 4 international and 5 European Olympiads in the last 5 years, as well as the head of physics team of the Faculty of Physics at Sofia University for 3 national student Olympiads. This work is summarized in three publications (№16, №17 and №18 from the B10 publication list), which are not indexed in world databases, but contain both interesting information and many problems (6 experimental and over 25 theoretical physical problems).

#### 5. Detailed analysis of basic and applied scientific contribution of applicant's record

In general, the basic and applied scientific contributions of the candidate can be characterized *as enrichment of existing knowledge by proving new facts and hypotheses*.

##### Contributions of the publications, distinguished as equivalent to habilitation thesis:

- $\text{Sc}_2\text{O}_3$  single crystals grown from high temperature solution-growth method, as well as  $\text{R}_2\text{O}_3$  powders (R – Sc, Er, Y, Ho, Gd, Eu and Sm) with the same crystal structure were studied and calculations of the crystal lattice dynamics were performed in order to determine the position, symmetry and the intensity of the lines [*publ. №1 and №2 of list 10B*]. A very good agreement between the experimental and theoretical data was obtained. Only in the case of  $\text{Eu}_2\text{O}_3$  a systematic deviation to lower frequencies was observed for some of the oxygen oscillations, and this anomalous behavior was attributed to oxygen vacancies. A correlation was observed between the frequencies of the most intense Raman peaks and the cubic lattice constant. Depending on the oxide, the frequency of oxygen oscillations decreases monotonically with increasing lattice constant, while the frequency of low-frequency modes (oscillations in which mostly rare earth ions participate) in the various oxides remains practically constant.

- The structural stability of  $\text{Sc}_3\text{CrO}_6$  single crystals was studied using Raman measurements at different temperatures and pressures [*publ. №3 from list 10B*] and the symmetry of all 18 lines observed at room temperature was determined. A decrease in the intensity of some of the lines was found with increasing temperature in the range 77 - 1273 K, and this was attributed to a phase transition to a more symmetric phase, which should have a smaller number of Raman active modes.

- Phonon oscillations in single crystals of  $\text{CuB}_2\text{O}_4$  were studied, using 4 different excitation energies and all possible scattering configurations in order to determine the dependence of line intensity on the wavelength of excitation and determine the symmetry of the observed lines, respectively [*publ. №4 of list 10B*]. Most of the oscillations have been identified on the basis of the comparison between the experimental data and the theoretical calculations of the lattice dynamics.

The contributions of the publications **outside of the habilitation thesis**:

- Surface Enhanced Raman Scattering (SERS) signal was successfully obtained from an aqueous solution of rhodamine 6G dye deposited on i) silver nanostructures grown on aluminum substrates [*publ. №5 of list 10B*] and ii) gold nanoparticles incorporated into a PVA (polyvinyl alcohol) matrix and deposited on a glass substrate (*publ. №13 from list 10B*). Enhancement in the range  $10^4 - 10^5$  was achieved at dye concentrations in the range  $10^{-6} - 10^{-7}\text{M}$ .

- Raman measurements at different temperatures have confirmed:

- ✓ A sequence of phase transitions and new phases discovered by optical and electro-optical microtexture analysis in composites comprising of hydrogen-bonded liquid crystals (nOBA) and various dopants such as carbon nanotubes, graphene flakes, perfluorooctanoic acid (PFOA), etc. [*publ. №7, №11 and №14 of list 10B*].

In general, a chiralization process was observed in the composites, which is not characteristic of pristine nOBA;

- ✓ the spinel structure and thermal stability of epitaxially grown  $\text{NiCo}_2\text{O}_4$  films at substrate temperatures above 550 °C [*publ. №8 of list 10B*];

- Raman measurements at different temperatures combined with theoretical calculations of crystal lattice dynamics have been successfully used to identify 22 of 24 active modes in  $\alpha\text{-FeOOH}$  (goethite) samples [*publ. №10 from list 10B*].

- The developed models for theoretical calculation of the crystal lattice dynamics are implemented for calculation of the frequencies of the infrared-active modes for the ordered phase of the reverse spinel  $\text{LiFe}_5\text{O}_8$  [*publ. №9 from list 10B*], determination of the frequencies

and symmetry of Raman and infrared active modes of  $\text{NdBaCo}_2\text{O}_{5+x}$  ( $x = 0, 0.5, 1$ ) [publ. №15 from list 10B] and for calculation of the dispersion of phonon - polaritons interactions in the the composite comprising Si-matrix and particles of  $\beta\text{-FeSi}_2$  and  $\text{Mg}_2\text{Si}$  [publ. №12 from list 10B]

- Raman spectroscopy was used for identification of mineral pigments and other inorganic components of the primers, paints and protective coatings used on three oil paintings from the collection of the National Art Gallery in Sofia for restoration and dating of the paintings [publ. №6 of list 10B].

According to the applicant self-report on the contributions, his personal contributions can be summarized as measuring and analysing the Raman spectra and performing theoretical calculations of the lattice dynamics. The latter are essential in cases where there is insufficient data on the studied objects. I have no doubt in the originality of the applicant's contributions and as a confirmation I will mention the high citation rate of some of the peer-reviewed works: **84** citations of publ. № 2, **64** citations of №8, **21** citations of №1, etc., as well as many highly rated journals in which the results were published: *Physical Review B* (3 papers), *Journal of Applied Physics* (2 papers), *Journal of Molecular Liquids*, *The European Physical Journal Plus*, *Nanomaterials* etc.

#### **6. Critical remarks and recommendations**

I have no critical remarks, neither on the content of the materials presented, nor on their presentation.

#### **7. Personal impressions**

I do not know the candidate personally, but the impression that I have got after I examined the materials submitted in the competition is excellent. Obviously, this is a motivated, skilful and very active young scientist who deserves to be promoted. I only wish him to keep doing high level science.

#### **8. Conclusion**

After I have studied the materials and scientific papers submitted in the competition and on the basis of the analysis of their importance and their basic and applied scientific contributions, **I confirm** that the scientific achievements **meet** the requirements of ZRASRB, Regulations for its application and relevant Regulations of Sofia University "St. Kliment Ohridski" for holding the academic position "Associated Professor" by the applicant in a professional field 4.1. Physical sciences. In particular, the applicant **satisfies the minimum national require-**

**ments** in the professional field and no plagiarism has been detected in the scientific papers submitted at the competition.

I give my **positive assessment** of the applicant.

## **II. GENERAL CONCLUSION**

Based on the above, **I recommend** the scientific jury to propose to the selection committee in the Faculty of Physics of Sofia University "St. Kliment Ohridski" to **select Dr. Neno Dimitrov Todorov** for the academic position of "**Associated Professor**" in the professional field 4.1. Physical Sciences.

February 28<sup>th</sup> 2022.

Reviewer:

(Prof. Dr. Tsvetanka Babeva)