

Evaluation report

for the materials submitted for participation in a competition for the academic position of "Associate Professor" according to the announcement of Faculty of Physics, Sofia University "St. Kliment Ohridski" in the State Gazette, issue 87/19.10.2021, professional field 4.1. Physical sciences, scientific specialty "Electrical, magnetic and optical properties of condensed matter"

The report was prepared by Dianka Dimitrova Nesheva-Slavova, Professor at the Institute of Solid State Physics "Acad. G. Nadjakov" at the Bulgarian Academy of 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.

The only candidate who submitted documents for participation in the announced competition is Head Assist. Prof. Dr. Neno Dimitrov Todorov from the Faculty of Physics at Sofia University "St. Kliment Ohridski".

I. GENERAL DESCRIPTION OF THE SUBMITTED MATERIALS

1. Candidature data

The documents submitted by the candidate are very well described in the Application for participation in the competition and I will not describe them in detail here. They comply with the requirements of the Law for development of the academic staff in the Republic of Bulgaria (ZRAS RB), the Regulations for application of ZRAS RB and the Regulations on the terms and conditions for acquiring scientific degrees and holding academic positions at Sofia University "St. Kliment Ohridski" (PURPNSZADSU). The list of all scientific papers of the candidate includes 24 publications, the Hirsch factor is 7, and the submitted list of observed independent citations contains 269 titles. For participation in the competition, Dr. Neno Dimitrov Todorov presented a list of 18 publications. It includes 12 publications in highly prestigious international scientific journals with Q1 and Q2 (3 in Phys. Rev. B (impact factor for the last 5 years IF₅ 5,205), 3 in J. Appl. Phys. (IF₅ 2,747), 1 in Nanomaterials (IF 5,076), 1 in Eur. Phys. J. Plus (IF 3,911), 1 in J. Raman Spectrosc. (IF 3,133), 1 in J. Mol. Liq (IF 5.642), etc.), 2 articles in journals with Q4, 1 - with SJR and 3 - in Bulgarian unrefereed and non-indexed journal. A list for participation of Dr. Nenov in 12 projects is presented, of which 3 are international (1 under Horizon 2020), 3 are funded by the NSF of Bulgaria and 6 are funded by the NSF at Sofia University.

2. Details of the candidate

Dr. Neno Todorov became a "Master of Microelectronics and Information Technology" at the Faculty of Physics at Sofia University "St. Kliment Ohridski" in 2010, and in 2014, under the supervision of Prof. M. Abrashev, he successfully defended his dissertation on "Phonons in oxides with complex crystal structure" and was awarded the educational and scientific degree (ONS) "Doctor". In 2019, he completed a six-month postdoctoral specialization in the Department of Physics at the Free University of Berlin, Germany, where he worked on X-ray absorption spectroscopy of transition metal oxides. On February 18, 2013 he was appointed as an "Assist. Prof.", and since March 11, 2015 he has been a "Head Assist. Prof." in the Department of

Condensed Matter Physics and Microelectronics at the Faculty of Physics, Sofia University. He has a variety of computer skills (programming, modeling, visualization, etc.).

3. General characteristics of the scientific works and achievements of the candidate

The candidate's research work is related to the application of Raman spectroscopy to study the properties of various materials - single crystals (Sc_2O_3 , Sc_3CrO_6 , CuB_2O_4 , LiFe_5O_8 , etc.), thin layers (NiCo_2O_4) or powders ($\alpha\text{-FeOOH}$, R_2O_3 ($\text{R} = \text{Sc, Er, Y, Ho, Gd, Eu and Sm}$), $\text{NdBaCo}_2\text{O}_{5+x}$). Most of the studied materials are oxides, but since the samples are from different sources there are studies of oil paintings and samples of various nanostructured materials (silver nanostructures on aluminum substrate, nanocomposites, obtained by mixing hydrogen-bonded dimer liquid crystals with perfluorooctanoic acid/carbon nanotubes/graphene flakes, samples representing a Si matrix with embedded nanoparticles of FeSi_2 and Mg_2Si), etc. The contribution of Dr. Neno Todorov in the study of these materials is in carrying out measurements of Raman scattering under excitation of unpolarized and polarized light of various wavelengths, at different temperatures and pressures, study of resonance phenomena, analyzing spectra and looking for connections with the physical properties of the material. In some cases, Dr. N. Todorov has contributed to calculations of the lattice dynamics made, which are useful in determining the origin and symmetry of the observed lines. This is especially important when investigating new material for which there is insufficient literature data. The publication of the obtained scientific results in specialized scientific journals with high prestige and high citation rate speaks of their high scientific level.

The publications in the list for participation in the competition presented by Dr. Neno Dimitrov Todorov were not used to acquire the ONS "Doctor". The reference for fulfillment of the minimum national requirements under art. 2b of ZRASRB concerning 4.1. Physical Sciences and submitted other documents and evidences show that the requirements for indicators "A" and "B" are met, including the Additional requirements of the Faculty of Physics. The requirements for the other indicators have been exceeded, as the assets for indicators "E" and "Teaching experience" several times exceed the requirements.

4. Characteristics and evaluation of the teaching activity of the candidate

Head Assist. Prof. Dr. Neno Todorov had teaching activity as an Assist. Prof., and the presented document for his teaching activity in the last five academic years, shows that it deserves high praise (2046 hours in total). It includes lectures (General Physics, Optics, Raman Spectroscopy), seminars and workshops on lecture courses, as well as on Mechanics, Electricity and Magnetism, Probability and Physical Statistics. Under his leadership in 2021 two graduates successfully defended their master's diploma. The very active work of Dr. Neno Todorov, related to the pupils' physics training deserves special attention and high praise. It includes participation in national commissions for organizing and conducting six Physics Olympiads, four more spring and three autumn national physics competitions, as well as participation as a leader of the Bulgarian team in the 49th and 50th International Physics Olympiads in Lisbon and Tel Aviv, at the 3rd European Physics Olympiad in Riga and 2 Master of Physics events in Romania. Part of Dr. N. Todorov's work with pupils and as an author of physical tasks for national competitions and Olympiads is reflected in the last three articles in the list of articles with which he participated in this competition.

5. Analysis of the achievements of the candidate in the materials for participation in the competition

Important new information has been obtained about the origin and symmetry of the observed lines in the Raman spectra of a large number of materials, as well as about their structure, phase composition, stability, differences in properties related to temperature effects, etc. The results are of high scientific value and have attracted the interest of the scientific community. The numerical indicators (citations, impact factor, etc.) are commented in item 1.

- Based on the obtained data for seven C-type oxides R_2O_3 ($R = \text{Sc, Er, Y, Ho, Gd, Eu and Sm}$) and literature data for other six oxides, a well-defined dependence on the unit cell parameter of the frequencies of all the most intense Raman peaks was established. It has been shown that by using this dependence and the information on the symmetry of the peaks in the spectrum of Sc_2O_3 single crystal, defined in another publication from the candidate list, can be easily determined by the symmetry of the corresponding peaks for the rest of the oxides. This study has been cited in a total of 105 publications of other authors in prestigious scientific journals.
- The results of the Raman study of thin films of NiCo_2O_4 with spinel structure have also been cited 64 times. They show that in the films grown at higher substrate temperatures, the distribution of cations is close to that in the ideal reverse spinel, while those grown at lower temperatures are characterized by a mixed distribution of cations / charges in both tetragonal and octahedral positions.
- I cannot pay special attention to all the interesting results, but would like to mention a new result that is interesting and useful for the scientific practice. It has been shown that silver nanostructures with a high surface-to-volume ratio deposited on an aluminum substrate can be successfully used as materials suitable for surface-stimulated Raman scattering. This is an important modern technique for detecting and tracking insignificant amounts of adsorbed chemically and biologically active molecules.
- In order to help the restoration and dating of three oil paintings belonging to the National Art Gallery, Raman spectroscopy has been successfully applied to identify mineral pigments and other inorganic components of the paints used.

Some of the studied materials have potential applications in various technological fields and this motivates their in-depth study. For example, thin films of NiCo_2O_4 are attractive for applications such as fuel cell electrodes, oxygen catalysis, alkaline reduction and aqueous electrolysis. The high stability established by Dr. N. Todorov and co-authors in heat treatment of these films up to 600°C in air or oxygen is of practical interest. Studies of rare earth oxides of the R_2O_3 type are important because these oxides can be used as electrolytes in solid oxide fuel cells, materials with a highly hydrophobic surface, catalysts for chemical reactions, optical elements of high power lasers, etc.

6. Critical remarks and recommendations

I have no critical remarks and recommendations on the publications of the candidate, but have two remarks concerning submitted documents: 1) I found evidences of the applicant's participation in only 5 of the 12 projects in the project list (3 international and two NSF BG projects); 2) In the file with abstracts of the publications of Dr. Neno Todorov the abstracts are

presented only in the language in which they are published which is not in accordance with the requirements of art. 4 (13) of ZRAS RB and art. 107(1), item 17 of the PURPNSZADSU.

7. Personal impressions of the candidate

I have no personal impressions of Dr. N. Todorov; but I have excellent impressions of the quality of scientific results and his work with students.

8. Conclusion on the application

After getting acquainted with the materials and scientific papers presented in the competition and based on the analysis of their importance and the scientific and applied contributions contained in them, I confirm that the scientific achievements meet the requirements of ZRAS RB, Regulations for its application and PURPNSZADSU for occupation by the candidate of the academic position "Associate Professor" in the professional field 4.1. Physical sciences. The candidate satisfies the minimum national requirements in the professional field and no plagiarism has been established in the scientific papers submitted at the competition.

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

II. OVERALL CONCLUSION

Based on the above, I recommend the scientific jury to propose to the Faculty Council of the Faculty of Physics at Sofia University "St. Kliment Ohridski" to elect Head Assis. Dr. Neno Dimitrov Todorov to take the academic position of "Assoc. Prof." in the professional field 4.1. Physical sciences, scientific specialty "Electrical, magnetic and optical properties of condensed matter".

23.02.2022

Signature:

/Prof. Dr.Sci. D. Nesheva-Slavova/