



Sofia University "St. Kliment Ohridski"

OPINION

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REGARDING: Competition for the occupation of the academic position "**professor**" in the field of higher education 4.3. Biological Sciences (Microbiology - Antibacterial effect of nanomaterials) in the Faculty of Biology at the SU "St. Kliment Ohridski".

The current contest was announced for the needs of Faculty of Biology at Sofia University "St. Kliment Ohridski". Protocol No. 3/ 30.01.2024 from the Faculty Council appointed a scientific jury to supervise a competition for a professor in the professional field 4.3. Biological Sciences (Microbiology-Antibacterial effect of nanomaterials), announced in State Gazette No. 103/12.12.2023 with candidate Associate Professor Dr. Iliyana Atanasova Ivanova.

As a member of the appointed scientific jury, I declare that I have no joint publications, research projects or any other type of conflict of interest within the meaning of para. 1, items 3 and 5 of the LDASRB with the only candidate evaluated in the competition - Associate Professor Dr. Iliyana Atanasova Ivanova from the Department of General and Industrial Microbiology of the Faculty of Biology at SU "St. Kliment Ohridski". The documents submitted by the applicant correspond to the instructions published in the Regulations for the Implementation of the Law on the Development of the Academic staff in the Republic of Bulgaria.

1. BRIEF INFORMATION ABOUT THE CANDIDATES IN THE COMPETITION.

Associate Professor Iliyana Atanasova Ivanova is the only candidate in the contest for the academic position "professor". The competition was announced by SU "St. Kliment Ohridski" for the needs of the Department of General and Industrial Microbiology in the Faculty of Biology (FB). Assoc. Prof. Ivanova holds a master's degree in Biochemistry and Microbiology at the Faculty of Biology, SU (1981 - 1986), and subsequently defended a dissertation in the same faculty for the award of an educational and scientific PhD degree on the topic "Microflora of the Tyulenovo oil field and opportunities for its practical application" (1994). Her career development continued at SU, successively holding the positions of assistant, senior assistant, assistant professor and associate professor.

2. FULFILLMENT OF THE REQUIREMENTS FOR OCCUPIING THE ACADEMIC POSITION "PROFESSOR".

Prof. Ivanova presents detailed reports on the fulfillment of the national requirements of the Law on the individual indicators, as well as on the fulfillment of the additional requirements for

occupying the position "professor", according to the Regulations. A review of the documents shows that the number of points for some indicators is even higher than required.

3. FULFILLMENT OF MINIMUM NATIONAL REQUIREMENTS ACCORDING TO LDASRB.

All documents presented by Prof. Ivanova for the competition show full implementation and even exceeding of the minimum national requirements:

Group of indicators A - 50 points: Successfully acquired educational and scientific PhD degree on 25.05.1994.

Group of indicators C - C.4 - 100 points: Habilitation thesis "Biological effects of nanomaterials", University Publishing House "St. Kliment Ohridski" - 224 pages.

Group of indicators D - D.7 and D.8 - 267 points: Scientific publications in international journals that are referenced and indexed in world-renowned scientific information databases Scopus and Web of Science in the period 2018-2024 - 16 scientific articles with IF (Q2-7; Q3-8; Q4-1) and published book chapter or collective monograph (Q3).

Indicator group E – E.11 – 336 points: Citations for the competition period: ♣ in publications referenced in Scopus and Web of Science: 168 in total ♣ in journals that are not referenced in global databases (with reviewers): 36 in total.

Group of indicators F - 175 points: PhD students: one successfully defended - 25 points, and one in the process of training; graduates: 24 successfully defended their degrees, 7 of them bachelors and 17 masters in the period 1997-2023.

An excellent impression is made by the fact that Assoc. Prof. Ivanova has been a participant or a coordinator in a large number of scientific and educational projects: Projects specifically financed by the state budget (5); Projects financed under operational programs (BG05M2OP001-2.09-0013 "Doctoral center "St. Kliment Ohridski", OP Science and education for intelligent growth 2017 - 2019, head of doctoral course "Nanomaterials and interactions with cells"); Projects financed by the Scientific Research Fund at the Ministry of Education and Culture - a total of 7 projects, as a participant). In regard to this **Indicator F.14**, the points are as follows: participation in a national scientific or educational project - 30 points for 3 contracts. Participation in an international research project with national co-financing - 4 projects for a total of 80 points.

Indicator E.19 - Published university textbook or textbook that is used in the school network - "Ecotoxicology and nanotechnology" 2018, University Publishing House "St. Kliment Ohridski" - 40 points.

The overall IF is 31.61; H-index: 8 (Scopus) and SJR-6.071, (Web of Science) – 7.

Her commitments also include the position of academic mentor in projects of the Ministry of Education and Science, financed by OP "Science and Education for Intelligent Growth" (BG05M2OP001-2.002-0001 "Student practices" - phase 1 (2017-2020); BG05M2OP001-2.013-0001 "Student practices" - phase 11 (2020-2023). Participation in scientific conferences after habilitation 2014: international and with international participation - 22 participations with reports and posters, and national conferences - with 11 posters and reports.

4. EVALUATION OF THE CANDIDATE'S SCIENTIFIC PRODUCTION FOR THE OVERALL ACADEMIC WORK.

Prof. Ivanova presents a habilitation report describing the research work participating in this competition. With respect to the topics, the mentioned scientific works are undoubtedly oriented towards the solution of modern scientific challenges.

In my opinion, the importance of the monograph written is high - both for entering into the physico-chemical and molecular details of the mechanisms of antimicrobial activity of nanomaterials, and for establishing the specific mechanisms of toxicity and gene expression and reactions of the affected pathogens, related with the change in environmental conditions:

- For the first time, emphasis is placed on clarifying the mechanisms of action of hydrophobic nanomaterials on living cells, which is a contribution of a fundamental scientific nature;
- Studies have shown that the addition of copper nanoparticles to silver-titanium thin films has a stronger antimicrobial effect, and the most pronounced bactericidal effect is demonstrated for thin films of titanium, silica and silver. This fact is of high value for the preparation of coatings for medical devices, antibacterial surfaces and hospital clothing in order to reduce the spread of nosocomial infections.
- The importance of organic nanocomposites is also described. Collagen as a natural product with excellent biocompatibility, adsorption capacity and hemostatic activity is one of the most commonly used biomaterials in tissue engineering.
- The study of nanomaterials is a new science implementing biology, physics and chemistry, studying the nature and processes of connection and interaction between them and in the system "microorganisms - environment - humans", with the aim of preserving and managing biological diversity and human health. Due to this interdisciplinarity, the monograph proposes the creation of a joint coordination network uniting various specialists in determining the safety of nanomaterials.

The contribution of the Ecotoxicology and Nanotechnologies textbook (University Publishing House of St. Kliment Ohridski, 2018) is important as well for familiarizing the students with basic concepts such as toxin, toxicity, poison, minimum harmless dose, therapeutic dose, therapeutic index, toxic and lethal dose and others, as well as the approaches to their determination; specific approaches for determining toxicity and antibacterial effect of newly synthesized nanomaterials and nanocomposites are presented. Both scientific works demonstrate the admirable ability of Assoc. Prof. Ivanova to conduct an in-depth analysis of the subject, which undoubtedly contributes to the complete and detailed insight of the readers into the described concepts and processes.

On the other hand, a summary is formulated with the main important contributions of the candidate's activities, which are divided into three general aspects, corresponding to the topic of the announced competition:

RESEARCH OF MONOMETALLIC, METAL OXIDE AND NONMETALLIC NEWLY SYNTHESIZED NANOMATERIALS WITH ANTIMICROBIAL ACTIVITY

- Important conclusions from the obtained results are that the most cytotoxic for the bacteria tested are silver, copper, zinc-oxide, niobium, SeNPs, followed by Au-PVP and AuNPs.

Graphene-oxide NPs also showed a stand-alone cytotoxic effect, especially on *B. cereus* NBPMKK1095.

- A comparative assessment of the antibacterial effect of commercial nanoparticles (selenium, gold, iron oxide, silicon oxide and graphene oxide) in the form of dispersions was made, and a concentration-dependent effect of the investigated particles on their antibacterial activity was demonstrated.

PREVENTION OF MICROBIAL ADHESION AND BIOFILM FORMATION

- The antibacterial properties of collagen nanocomposites linked to graphene, graphene oxide, (GO), zinc-oxide and metal nanoparticles were studied and their pro-, antioxidant and biological activity was evaluated by luminescent and standard microbiological methods. Broad-spectrum antimicrobial activity against *Firmicutes* (*Staphylococcus epidermidis*, *Bacillus cereus* and *Candida lusitanae*) and *Gracilicutes* (*Escherichia coli*, *Salmonella enterica* and *Pseudomonas putida*) microorganisms has been reported.

- A combination was proposed for formulation of new composite biomaterials (collagen/(ZnTiO₃)) and they were obtained by using sol-gel cryogenic drying technology to preserve the natural collagen activity in order to decrease the agglomeration of the nanoparticles and to increase their activity.

CREATION OF BIOLOGICALLY ACTIVE THIN FILMS WITH ANTIMICROBIAL ACTIVITY

- On the basis of a proposed idea for the composition of thin films, the metal ingredients and their ratio were formulated, as well as the method of their processing. These results would be extremely useful in the production of antimicrobial film in hospitals, public facilities, in the food and pharmaceutical industries. Magnetron sputtering in the form of thin biofilms on medical devices would contribute to the reduction of infections in hospital facilities.

In theoretical and methodological aspects, the candidate's developments reveal the following valuable contributions: numerous studies of the biological and antioxidant activity of newly synthesized nanoparticles, nanoclusters and nanocomposites have been carried out; A comparative assessment of the antibacterial effect of different types of nanomaterials was made; The key role of the size and shape of the nanoparticles for the effectiveness of their inhibitory and bactericidal effect has been confirmed; New biofilm-preventing anti-adhesive composites with fucoidan, antioxidants and siloxane polymers have been developed for the first time. This is innovative research with great potential for application against the formation of microbial biofilms on various surfaces.

5. EVALUATION OF EDUCATIONAL AND METHODOLOGICAL ACTIVITY.

The candidate Assoc. Prof. Iliyana Ivanova has demonstrated an admirable and intensive teaching activity since the start of her career as an assistant professor at SU. In her role as a staff member at the "General and Industrial Microbiology" department, she has performed a number of important lecture courses and exercises for various specialties:

- For majors with a MASTER's degree: "Microbiology and microbiological control" - lectures on Sanitary microbiology; "Quality and safety of food" - lectures on Physico-chemical and

biochemical control of food, exercises; as well as lectures and exercises for distance learning.

- For majors with a BACHELOR's degree: "General Microbiology with Virology" for binary majors, lectures and exercises; "Biology" part-time study, lectures on Microbiology; "Biotechnology" -exercises in Microbiology; "BMSD" - optional Bioethics, lectures and exercises; "BMSD" - Ecotoxic tests for environmental control, lectures and exercises.
- Postgraduate qualification course "Cellular interactions with nanomaterials" at the FB-SU "St. Kliment Ohridski" 2017
- Doctoral course "Nanomaterials and interactions with cells", approved by FC-FB from 27.02. 2018 and conducted second semester 2018.
- Dr. Ivanova's educational and teaching activities include the supervision of graduates from bachelor's and master's programs (24 in total), as well as the supervision of doctoral students.

6. PERSONAL IMPRESSIONS OF THE CANDIDATE.

My acquaintance with Assoc. Prof. Iliana Ivanova is quite scanty, through common participation in scientific conferences and seminars. On the basis of the application documents presented, I can summarize that her competencies in the field of microbiology and biotechnology are exceptional, which shows dedication to the work and concentration in setting and achieving scientific goals.

7. CRITICAL NOTES AND RECOMMENDATIONS.

The presented documents have been prepared according to the requirements for the competition. I have no remarks or recommendations for the candidate.

8. CONCLUSION

All in all, based on the documents and evidence presented in this contest, I consider the candidate Associate Professor Ivanova fully compliant with the criteria for occupying the academic position "professor".

Assoc. Prof. Iliyana Ivanova is a specialist with an established and long-term experience in the field of microbiology. Her scientific work is wide-ranging, analytical and of proven value. This fact finds recognition in her internationally recognized scientific publications, participation in conferences and projects, teaching, course development and created teaching books. The specialists working with her, as well as her students and PhD students can count on her professionalism in the field of microbiology.

All of the above gives me a definite cause to determine my positive assessment and to recommend to the members of the honorable scientific jury to support **the candidate Assoc. Prof. Iliyana Atanasova Ivanova in occupying the academic position "professor" in the Department of General and Industrial Microbiology at SU "St. Kliment Ohridski", in higher education professional field 4.3. Biological Sciences (Microbiology - Antibacterial effect of nanomaterials).**

Date: 26/03/2024

Signature:

/Assoc. Prof. Nedelina Kostadinova/