# OPINION

of

Acad. Roumen Georgiev Pankov, member of the Scientific Jury, appointed by order No. 749/17.09.2025 of the Director of the Institute of Biophysics and Biomedical Engineering at the Bulgarian Academy of Sciences

on

a competition for the selection of an "associate professor" in the field of higher education 4. Natural sciences, mathematics and informatics, professional area 4.3. Biological sciences, scientific specialty "Biophysics", announced in the State Gazette No. 58/18.07.2025 for the needs of the section "Electroinduced and adhesive properties" at the IBPhBME – BAS

One candidate submitted documents for participation in the competition – senior assistant professor Kamelia Todorova Hristova-Panusheva from the "Electroinduced and Adhesive Properties" section at the Institute of Biophysics and Biomedical Engineering. She is a graduate of Sofia University "St. Kliment Ohridski", where in 2005 she graduated with a master's degree in Cell Biology and Pathology. Her professional career developed at the Institute of Biophysics and Biomedical Engineering, where she began working as an assistant professor immediately after graduating from university. Since 2006, she has been a full-time doctoral student in the "Electroinduced and Adhesive Properties" section at the same institute, where, after successfully defending her doctoral dissertation (2009), she was elected as a senior assistant professor – a position she holds to this day.

Senior assistant professor Hristova-Panusheva has been on short-term specializations in Spain and Germany.

According to the submitted documents, she has over 16 years of work experience in the specialty, which fully satisfies the requirements of the Regulations for the Implementation of the ZRASB at the IBPhBME at the Bulgarian Academy of Sciences.

The main scientific directions presented in the research of Dr. Hristova-Panusheva are related to the studies of the interaction between cells, nanoparticles and the surfaces of new biomaterials. In my opinion, the main scientific achievements in each of the directions can be summarized as follows:

1. Nanoparticles and laser-activated photothermal therapy

- Effective conversion of light into heat and destruction of cancer cells by ultra-small plasmonic gold nanoparticles irradiated with a femtosecond laser has been demonstrated.

- Graphene oxide (pure and PEG-modified) has been found to be an effective photothermal converter under low-intensity femtosecond laser irradiation, which allows cytotoxicity at safer energy levels.

- Optimal irradiation parameters and nanoparticle concentrations have been determined that ensure reproducible destruction of hepatocellular carcinoma (HepG2) cells and provide applicable protocols for preclinical studies.

2. Graphene Functionalization and Toxicological Evaluation of Nanoparticles

- It has been proven that chemical functionalization (amination and PEGylation) significantly alters the biological activity of graphene oxide — increasing the antitumor effect in some modifications, but leading to dose-dependent genotoxicity and mitotoxicity in others.

- Toxicological analyses (genotoxicity, mitochondrial ATPase activity, liver enzymes) have been performed, revealing critical molecular markers that should be considered for the safe application of nanomaterials.

3. Cellular and molecular mechanisms of action of nanoparticles

- A causal relationship has been established between the entry of nanoparticles, local heating, mitochondrial dysfunction and the generation of reactive oxygen species to the activation of apoptosis/necrosis in HepG2 cancer cells.

- It has been shown that the surface chemistry of nanoparticles (PEGylation, amination) alters their intracellular localization and, accordingly, the balance between thermal and oxidative mechanisms of cell death.

4. Dependence of biocompatibility on plasma-polymer coating and surface chemistry

- Plasma-polymerized hexamethyldisiloxane (HMDSO) films with controllable hydrophilicity have been developed, and it has been shown that surface energy directly affects protein adsorption and cellular response, providing a new tool for controlling biocompatibility.

- It has been found that simple plasma treatments can significantly improve the biological properties of the surface - a fast and effective method for functionalizing medical materials.

5. Nanocomposite coatings and mechanical reinforcement for medical applications

- Nanodiamond-reinforced plasma polymer coatings with increased elastic modulus and wear resistance have been created, without loss of biocompatibility, which is a step towards creating long-lasting medical implants.

- The biocompatibility and corrosion resistance of $TiN/TiO_2$ bilayer coatings have been confirmed, making them suitable for coatings on implantable devices.

6. Mechanobiology — influence of substrate stiffness on cell fate

- It has been shown that material stiffness directly regulates stem cell differentiation: increased elasticity and nanodiamond reinforcement stimulate osteogenesis, while supraphysiological elasticity promotes myogenic differentiation.

- The relationships between elastic modulus and cell differentiation type have been quantified.

7. Cell adhesion, focal adhesion proteins and biochemical regulators

- It has been found that pharmacological agents (e.g. halothane) and novel plant cystatins alter the distribution of focal adhesion proteins and the adhesion of epithelial and cancer cells, revealing new mechanisms of cell adhesion.

- Differences in the adhesion behavior between normal and tumor cells have been identified, which can be used to develop surfaces with controllable adhesive properties.

8. Biocompatibility and translational evaluation of natural extracts and nanomaterials

- Biocompatibility studies (genotoxicity, mitotoxicity, cytotoxicity) of both plant extracts and engineered nanoparticles have been performed, providing realistic toxicological profiles for potential therapeutic applications.

- Specific physiological risks (disorders in liver enzymes, mitochondrial function, and cardiac activity) have been identified, which outline priority areas for future research.

The conducted research has been published in the form of 19 scientific articles (all with impact factor or SJR) and one chapter of a book published by Academic Press, with which senior asst. prof. Hristova-Panusheva participated in the current competition. These publications do not repeat the articles for the award of the educational and scientific degree "Doctor". Applying the adopted division by quartiles, the distribution of publications in the competition is as follows: 8 are in quartile Q1, 2 - in Q2, 2 - in Q3 and 3 - in Q4. The total impact factor of the articles in the competition, according to the information presented, is 38.47, and the citations of the same in the documents are 50. According to the information in Scopus, Hristova-Panusheva's Hirsch index is 7. These scientometric data are an attestation of the good quality of the presented scientific production.

The above-mentioned scientometric data not only cover, but also exceed the criteria for awarding the academic position of "associate professor" specified in the regulatory documents. The required and achieved points by Senior Asst. Hristova-Panusheva are summarized in the table below:

| **Indicator** | **Required minimum** | **Number of points achieved** |
|---|---|---|
| А | 50 | 50 |
| Б | 100 | 125 |
| Г | 220 | 239 |
| Д | 60 | 100 |
| **Total** | **430** | **514** |

Dr. Hristova-Panusheva actively participates in the implementation of various national and international scientific projects, which is evident from the information presented for participation in 6 research projects.

**Conclusion**: Dr. Hristova-Panusheva participates in the current competition with scientific research in a clearly defined and modern scientific field, which fully corresponds to the topic of the announced position. Her research combines nanomedicine, biomaterials and cell biology with the aim of creating innovative nanostructured materials and surfaces for precise and regenerative medicine. The topic is extremely relevant and significant, as it meets modern scientific priorities related to personalized therapy, tissue regeneration and the safe application of nanomaterials in medicine. Her scientific contributions, as well as the number, quality and international impact of the published articles fully satisfy, and even exceed, the requirements set out in the Regulations for the Implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria for the IBPhBMI-BAS. Based on this, I express my positive assessment and convinced recommendation to the esteemed members of the scientific jury to elect senior assistant professor Dr. Kamelia Todorova Hristova-Panusheva to occupy the academic position of "associate professor".

12/11/2025

Signature:

/acad. Roumen Pankov/