REVIEW

of an application for the academic position "Associate Professor", in the professional field 4.2. Chemical sciences, for the scientific specialty "Physical chemistry", demanded by the section "Surfaces and colloids", with requirements to cover the topic "Electrical properties and stability of colloid-polymer suspensions", announced in State Gazette, number 45 of data 28/05/2021 with a sole candidate:

Ch. Assistant Professor Dr. Kamelia Pavlova Kamburova-Petkova

Reviewer: Professor Konstantin Todorov Balashev

1. General requirements and brief factual data of the candidate.

Kamelia Pavlova Kamburova - Petkova was born on October 10, 1977 in the city of Pleven. In 1996 she graduated from the Spanish language high school "Miguel de Cervantes" in Sofia. In 2002, after defending her master's thesis titled: "Study of human tissues by the method of reflective spectroscopy" she graduated as MSc in Physics at the Faculty of Physics at Sofia University "St. Kliment Ohridski", and obtaining a specialization in Medical Physics and Meteorology. During the period between 2004 and 2006, she was a full-time Ph.D. student at the Institute of Physical Chemistry "Acad. R. Kaishev" of BAS (IPhCh-BAS). In the course of her Ph.D. study, between 2006 and 2007, she had two visits to the University of Bayreuth, Germany as a scholar in the group of Prof. Heinz Hoffmann at the Center for Colloids and Surfaces. In 2009, after a successful defense of her dissertation "Electrical properties and thickness of multilayer films of biopolymers on colloidal particles", Mrs. Kamburova-Petkova was awarded by the Higher Attestation Commission a Ph.D. degree in Physical chemistry (diploma № 33401 /20.07.09). She started her first job at the IPhCh-BAS in 2007 as a staff physicist, and then in the period between 2009 and 2011 she was consequently promoted to a research associate II degree, and then to a chief assistant professor, a position she currently holds. Since 2019 she also holds a position as a part-time lecturer in physics at the Technical University of Sofia.

Up to now (26.08.2021) in the database "Scopus" one can find 21 articles by Dr. Kamburova-Petkova. Her Hirsch index is 10, calculated without taking into account the self-citations of all co-authors.

2. *Description of the submitted materials.*

Dr. Kamburova- Petkova has presented a report on the Implementation of the minimal national requirements, the requirements of BAS and the requirements set by the Scientific Council of IPhCh-BAS, respectively, and she has arranged them appropriately in a tabular form. She participates in the contest for

Associate professor position demonstrating scientific achievements, which consist publications in the leading international and national journals or reports at the respective scientific forums.

Dr. Kamburova - Petkova has presented a list of 21 publications. Five of them are included in her PhD dissertation, and another five are included in the list of publications that has an equivalent of a habilitation thesis. Most of the publications presented in the general list are in renowned specialized and leading journals in the field of colloid chemistry, such as: Journal of Colloid and Interface Science (4), Langmuir (2), Colloids and Surfaces A: Physicochemical and Engineering Aspects (8), Colloid and Polymer Science (2), Biomacromolecules (2) and others. Dr. Kamburova - Petkova is the first author in 13 and the second author in 12 publications. All submitted publications cover entirely the scope of the announced contest. Dr. Kamburova - Petkova has presented a list of 8 research projects funded by state funds and the Ministry of Education and Science, in which she is a participant and one in which she is a leader. She is also a participant in 8 projects under European and international programs and funds and 2 projects on international cooperation in the framework of inter-academic treaties and agreements (EBRD).

The indicators for the scientific activity of Dr. Kamburova- Petkova exceed both the minimal national requirements and those of BAS and IPhCh-BAS which are obligatory for the scientific activity of the candidates for the academic position "Associate Professor".

Group Indicators	National requirements	Requirement of BAS	Requirement of IPhCh-BAS	Points scored
А	50	50	50	50
В	100	100	100	175
Г	200	220	220	235
Д	50	60	60	72

3. General characteristics of the research and scientifically applied activities of the candidate.

The research and scientifically applied activities of Dr. Kamburova-Petkova are focused on topics that are relevant to the announced European and national priorities in the contemporary chemistry of colloids. Her research can be systemized in two main areas:

1) Electrical properties and stability of colloid particles in aqueous suspensions with additives of polyelectrolytes;

2) Design, preparation and characterization of multilayer films of polyelectrolytes on colloidal particles.

The main results of Dr. Kamburova-Petkova's research were obtained using electro-optical methods. She analyzed the electrical polarizability and size of non-spherical colloidal particles by applying polyelectrolytes as stabilizers or flocculants of colloidal suspensions in order to control the production of multilayer coatings of polymers, as well as for encapsulating active substances for medical applications or for protecting metals from corrosion.

4. Main scientific and scientifically-applied contributions

The main contributions of Dr. Kamburova-Petkova can be systematized according to the above mentioned two areas of research, as follows:

4.1. Studies by means of electro-optical methods and microelectrophoresis of electrical properties and resistance to aggregation of colloid-polyelectrolyte aqueous suspensions of model oxide particles (β-FeOOH - β-ferrioxy hydroxide) depending on the charge of the adsorbed polymers and the characteristics of the dispersed medium [№ 2 , 5, 7, 9, 10, 11, 12]. In these studies, it was shown that the amount of polymer that causes an aggregation in the suspension when it is adsorbed on oppositely charged oxide particles, it decreases with the increase of charge density of the polymer [№ 9]. The fraction of condensed counterions in highly charged free polyelectrolytes' solutions (Manning's theory) was evaluated and was compared with a case in which the polyelectrolytes were adsorbed on poorly charged particles (Sens and Joanny's theory) [№ 2]. A decrease in the mobility of the counterions of adsorbed polymers in an electric field was found when compared with the mobility of free ions in solution [№ 2, 5, 7, 9, 12]. A theoretical model which explains the increase of the charge of weak polyelectrolyte by increasing the length of its chains, is proposed, taking into account the counterions' condensation phenomenon [№ 10]. The influence of the charge distribution of the polyelectrolyte on the electrical properties and the stability of a suspension of oxide particles has been established [№ 12]. It has been shown that the electrical polarizability and the thickness of layers of highly charged polyelectrolytes adsorbed on poorly charged colloidal particles increase when the amount of low molecular weight salt in the medium also increase [№ 11].

4.2. Preparation of multilayer films on colloidal particles by polyelectrolytes by means of sequential adsorption of oppositely charged polymers on model colloidal particles of β-FeOOH [№ 3, 4, 6, 8, 14]. The electrical properties and the thickness of the films are determined and a mechanism of growth of films of weak polyelectrolytes is proposed, which allows the thickness of the films and their electrical properties to be

regulated by alterations of the medium's pH. It has been found that the film thickness of two strongly dissociated biopolymers increases linearly as a function of the number of layers. It was also found that the formed films are thin, while when strongly dissociated polymers are combined with weakly dissociated ones, the thicker films are produced and their increase can be either linear or exponential [№ 3, 4, 6, 8]. Exponential growth is explained by a diffusion mechanism [№ 4, 6, 14], while linear growth is associated with partial desorption from the film surface of quasi-soluble complexes [№ 3, 8, 14]. A correlation between the charge of the polyelectrolytes involved in the formation of the films, and the value of the electrical polarizability of the colloidal particles coated with multilayer films was found [№ 3, 4, 6, 8, 14]. It has been found also that the amount and mobility of the small counterions in the last adsorbed polymer layer is responsible for the electro-optical behavior of the whole films. It has been shown that the electrical polarizability of films which last layer is composed of dissociated, highly charged polyelectrolyte most strongly depends on the counterions, whose mobility is reduced in comparison to the mobility of the free ions in the solution. This is confirmed by a comparative study of the electrical polarizability of highly charged carboxymethyl cellulose before and after its adsorption on model colloidal particles [№ 5].

4.3. Encapsulation of drugs and corrosion inhibitors with polyelectrolytes for purposes of improving their biocompatibility, release's rate control as well as their target and dosage properties. A procedure for encapsulation of nanoparticles of the anti-inflammatory drug indomethacin (IMC) has been developed. It includes a pre-treatment of an aqueous suspension of IMC microcrystals by means of ultrasound and subsequent encapsulation of the drug with a multilayer film of two natural polysaccharides - pectin and chitosan] [13].

4.4. Encapsulation of corrosion inhibitors by a layer-by-layer technique of two charged polyelectrolytes adsorbed sequentially on nanoparticles of hematite [№ 15] or kaolinite [№ 22]. The steel corrosion inhibitor benzotriazole (BTA) is embedded in polymer shells that contain a pH-dependent polyelectrolyte and can release it when the pH changes during the corrosion process. In nanocontainers with a hematite core, it has been found that the amount of inhibitor retained in the coating depends on the charge of the last adsorbed polymer layer.

4.5. Stabilization of colloid suspensions for preparation of anti-corrosion zinc coatings deposited on steel with embedded polymer nanocontainers impregnated with steel corrosion inhibitors [№ 17, 19, 23, 26]. Optimal conditions have been found for the preparation of stable suspensions of nanocontainers (e.g., pH, ionic strength of the medium, concentration of polyelectrolytes and inhibitors), suitable for the incorporation into the zinc coating by co- or sequential electrodeposition of zinc from a weakly acidic solution of zinc

sulphate. The main interaction forces that cause the formation of polymer nanocontainers and the encapsulation of inhibitors in these shells are found to be electrostatic. The degree of dissociation of the negatively charged polyacrylic acid decreases as the pH of the medium decreases, which implies a decrease of the strength of the interactions between its chains with those of the positively charged polymers. Hence it increases the release of inhibitors trapped in the nanocontainers.

4.6. Zinc coatings with embedded nanoparticles, which are corrosion inhibitors of steel, are achieved by coating them with polymers [№ 20, 21, 24, 25, 27]. Optimal conditions have been found for obtaining stabilized against aggregation suspensions of particles of the conductive polymer polyaniline [№ 20, 21, 24, 27] and carbon spheres [№ 25] by means of adsorption on the particles of suitably charged [№ 20, 21, 27] and uncharged [№ 24, 25] polymers.

4.6. The reflectance spectroscopy method was applied to obtain the reflection spectra of a healthy tooth, and to compare it to the spectra obtained for various carious conditions and two pathologies - fluorosis and tartar. A primary diagnostic algorithm was proposed to determine the condition of the tissue that would allow the utilization of the method of reflective spectroscopy for early diagnosis of caries [№ 1].

4.7. The physicochemical properties of lipid nanotubes (LNT), their size and length and the type of their electrical polarizability have been studied [№ 16].

5. Impact of the candidate's research in Bulgarian and international scientific literature

In presented by Dr. Kamburova-Petkova documentation one finds 176 citations. Up to date, the database Scopus gives 185 citations without the self-citations of all authors. However, as it is well known, the Scopus and Web of Knowledge databases give a smaller number of citations because they omit the existing citations in doctoral dissertations. The most cited article from the main list of works of Dr. Kamburova-Petkova is an article [3] - 33 times. In general, the number of citations of her works varies between 4 and 20 citations per article. The documentation submitted for the contest shows that publications [13, 17, 26], are evaluated as the most significant scientific and applied achievements of the IPhCh - BAS for the years 2013, 2016, and 2020, respectively. In general, it can be concluded that the work of the candidate has a good impact on the scientific community.

6. Critical remarks and recommendations to the candidate

I have no critical remarks to Dr. Kamburova-Petkova and the documentation presented by her. I have , though an encouraging recommendation that might help her to develop a promising carrier. Up to now Dr. Kamburova-Petkova did research as a successor in one of the leading physicochemical schools and in

particular the field of the electro-optical properties of colloids, where the main and world-renowned contributions have made scientists such as Stoilov, Petkanchin, Radeva and others. Therefore, in order to preserve the legacy one of the main tasks for her future development should be to attract, involve and guide young and talented students in this scientific field. One can see that in the period 9.12.2019 - 31.03.2020, Dr. Kamburova-Petkova has already been a supervisor of two students from the Faculty of Biology at Sofia University "St. Kliment Ohridski", which is a good start in this regard.

7. Personal impressions o about the candidate

I do not know Dr. Kamburova-Petkova in person, but over the years I have followed the research of the group at IPhCh - BAS, in which she developed her career. Hence, I have indirect impressions of the importance of her scientific results which give me a belief that she has excellent prospects not only to continue the scientific traditions and achievements of the group "Surfaces and Colloids" at IPhCh-BAS, and particularly in the research area of "Electrical properties and stability of colloid-polymer suspensions", but also to make her personal contribution in the future scientific development of that group.

CONCLUSION

The documentation presented by Dr. Kamburova-Petkova, who is the only candidate in the announced contest for the associate professor at IPhCh - BAS, corresponds to the topic of scientific specialty 4.2. Chemical sciences, specialty "Physical Chemistry". She satisfies and even exceeds the requirements of the law, the Regulations for its application in the Republic of Bulgaria, and the Regulations for its application in IPhCh - BAS. The candidate's contributions are indisputable and clearly distinguishable within the scientific community.

The scrutiny of her research work and organizational activity in science give me a solid reason to believe with confidence and to support the application of **Ch. Assistant Professor Dr. Kamelia Pavlova Kamburova-Petkova** and to recommend to the members of the respected scientific jury and the esteemed scientific council of IPhCh- BAS to award her with the academic position "Associate Professor" in the field 4.2. Chemical sciences with a scientific specialty "Physical Chemistry".

17.09.2021 г.

Sofia, Bulgaria

(Prof. Konstantin Balashev, DSc)