EVALUATION REPORT

On the competition for the academic position "Professor",
Classification of professional field 4.2 Chemical Sciences
(Physical Chemistry –Formulation of disperse systems for Cosmetics and Household Chemistry),
Announced by Sofia University "St Kliment Ohridski" in SG no. 55/28.06.2024

Applicant: Krastanka Georgieva Marinova, PhD,
Associate Professor in the Department of Chemical and Pharmaceutical Engineering
Faculty of Chemistry and Pharmacy, Sofia University "St Kliment Ohridski"

Member of the Scientific Committee: Elena Dimitrova Mileva, DSc, Professor, IPC-BAS

1. Brief biographical notes

Associate Professor Dr Krastanka Georgieva Marinova has since 1992 a MSc degree of Engineering Physics ("Quantum electronics and laser techniques") from Faculty of Physics, in Sofia University "St Kliment Ohridski". During 1992-1994 she was a TEMPUS post graduate student in the Laboratory of thermodynamics and physicochemical hydrodynamics, Faculty of Chemistry in SU; she also had postgraduate stays abroad: 10 Department of Chemical Engineering, Patra University, Greece; 20 Research Center, Rhodia Silicones Europe, Lyon, France. In the period of 1995-1999 she was a PhD Student in the Laboratory of Chemical Physics and Engineering; she defended her PhD theses in Physical Chemistry ("Mechanisms of action and exhaustion of fast antifoaming agents") in 2002. Krastanka Marinova has worked in Faculty of Chemistry and Pharmacy, SU consecutively as a physicist (1994-1995, 1999-2003), as Senior Assistant (2003-2006) and Assistant Professor (2006-2009), and since 2009 is Associate Professor in Theoretical Chemistry (Separation Processes in Disperse Systems) at the Department of Chemical and Pharmaceutical Engineering. In the period 2012-2019 she was also Deputy Dean for Academic Affairs at the Faculty of Chemistry and Pharmacy of Sofia University "St. Kliment Ohridski". Kliment Ohridski".

2. Scientific and applied activities

The scientific activity of Assoc. Prof. Marinova is in the field of physical chemistry of surfaces and disperse systems. The main directions in which she has worked are related to the development and development of new experimental procedures for studying the interphase adsorption and rheological properties of inhomogeneous anisotropic layers on fluid phase boundaries, characterization and optimization of the composition of multicomponent disperse systems for applications, e.g. in the cosmetics industry and household chemicals. Dr. Marinova is the author of a total of 44 scientific publications, of which 32 are articles in specialized scientific journals, 10 are papers in conference proceedings, 2 are book chapters. She is an author of one patent (US Patent) and one patent application (US Patent App.).

In the competition, Assoc. Prof. Marinova participates with a total of 19 scientific papers, one book chapter (Colloid and Interface Chemistry for Nanotechnology, CRC Press, New York, 2016), one patent (US Patents) and one patent application (US Patents App.). Of the submitted publications, 13 are in reputable scientific journals with an impact factor, such as: Advances in Colloid and Interface Science

(IF=15.9, Q1) – 2; Journal of Colloid and Science (IF=9.4, Q1) – 4; Colloids and Surfaces A (IF=4.9, Q1) – 5; Langmuir (IF=3.7, Q1) – 1. She is the first author in 4 of the publications, and the correspondence author for 7 of them. So far, a total of over 1920 quotes of the works of Assoc. Prof. Marinova were noticed, and she participates in the present competition with over 480 quotes; The h-index of the candidate is 20. Of the articles in the list of scientific papers for participation in the competition, most citations are for those published in: Langmuir (2011) – 168 (D7.2); Adv.Coll.Inerf. Sci. (2014) – 98 (G7.5); J.Coll.Interf.Sci. (2012) – 59 (B4.4); J.Coll.Interf.Sci. (2009) – 37 (B4.1); J.Coll.Interf.Sci. (2015) – 36 (B4.7); Coll.Surf. A (2017) – 28 (B4.11); 4 of the other articles have more than 12 citations (B4.1, B4.6, D7.9, D7.10). The results of the candidate's research work have been presented as 42 materials (including 30 reports) at various scientific forums.

The materials provided for the competition fully correspond to, and exceed, the required points for the group of indicators for occupying the academic position of "Professor" at the Faculty of Chemistry and Pharmacy of Sofia University, namely: group A – 50 points (out of 50 points), group B – 115 points (out of 100 points), group G – 240 points (out of 220 points), group D – 976 points (out of 120 points), Group E – 260 points (from 150 points), group J– 551 points (from 120 points).

The author's reference list for the period after the habilitation in 2009 covers several groups of systems and phenomena, in the study of which Assoc. Prof. Marinova has significant scientific and applied scientific achievements. These include:

1. Development of new experimental approaches for the study of interfacial stress and rheology of fluid and 'solidifying' boundary surfaces between fluid phases (B4.1, B4.4, B4.7, G7.9, G9.21).

2. Experimental study of adsorption and rheological properties of fluid phase boundaries in systems with non-trivial properties (high surface elasticity and/or viscosity, etc.) (G7.2, B4.6, G7.10).

3. Characterization of multicomponent systems with applications in cosmetics and household chemicals (B4.11, G7.3, G7.12, G7.13, G7.15, G7.16, G8.8, G9.22, J24.5, J24.14, J24.17-20).

1. Most significant achievements of the studies in the first group, in my opinion, relate to the developed original methodology and equipment that allow synchronized pressure measurement and determination of the profile of axially symmetrical drops and bubbles at small time intervals. By processing the obtained data, the equipment can determine the local tensor components of the surface tension at different points of anisotropic and isotropic surface layers. The research is summarized in the review article G7.9; the methodology and instrumental modifications are described in a patent (G9.21, US Patent). The main new elements are the development of original additional methods: capillary meniscus dynamometry (CMD) and capillary bridge dynamometry (CBD), as well as the precise selection of the studied objects.

The following significant scientific results have been obtained:

1a. The rheological parameters of the interfacial boundary surface between the oscillating droplets of aqueous solution of surfactants and the oil phases of low and high viscosity (5÷10 000 mPa.s) are determined. The applicability of the method for determining the surface elastic modulus, which does not depend on the volumetric viscosity of the oil phase (B4.1), has been confirmed.

1b. The developed procedure and equipment was applied for the first time to determine the two main components of the surface tension tensor (in the direction of the "meridians" and "parallels") for elastic surface layers. In the case of hanging drops of HFBII protein solution, it has been shown that the elastic surface layer always has a larger component of surface tension in the direction of the meridians and at

the moment of folding the elastic layer, the component in the direction of the parallels takes negative values (B4.4, B4.7, G7.9).

1.c. The methodology is adapted to determine the stress tensor and adhesion force for fluid and elastic capillary surfaces formed by the interaction of bubbles or droplets with a solid flat surface (G7.9). A number of physicochemical parameters of the systems were measured: the components of the stress along the capillary profile, the equilibrium, advancing and retreating contact angles for fluid and elastic adsorption layers, the adhesion forces and the capillary bridge. The high sensitivity of the method allows the quantification of forces of the order of several μN, e.g. for protein adsorption layers.

2. The studies in the second group are related to the determination of adsorption and rheological properties of fluid phase boundaries from multicomponent systems containing natural surfactants, which are effective foam stabilizers and emulsifiers. The results obtained allow for a better understanding of the structure and properties of these systems, as well as the leading factors that determine them.

Here I will note some of the most interesting achievements.

2a. Studies of the basic properties of surface adsorption layers of Quillaja saponins show important details of their structure and the area of the molecule (is ≈1 nm^2) on the surface has been determined. With small surface deformation, the adsorption layers of saponin have a very high surface tensile elasticity (280 ± 30 mN/m) and significantly lower slip elasticity (26±15 mN/m). It has been shown that in biosurfactants with highly elastic surface layers, the oscillating hanging drop (ADSA) method is not applicable (G7.2). This is the most cited work of Assoc. Prof. Marinova from the list for participation in the competition (168 citations).

2b. Important results were obtained for the surface adsorption and rheological properties of mixtures of hydrophobin (HFBII) and sodium dodecyl sulphate (SDS) at the water/air interface depending on the concentration and sequence of adsorption (B4.6). The interphase adsorption and rheological properties for mixtures of hydrophobin with other proteins at the water/oil interface have also been investigated. It has been established that there are conditions for irreversible adsorption of hydrophobin and for 'solidification' of the adsorption layer of hydrophobin below a certain threshold value of the interphase voltage (G7.10).

3. The main part of the publications in the competition in the third group is related to essential scientific and applied research, which is important primarily for the cosmetic industry and in household chemicals. Assoc. Prof. Marinova has obtained systematic results on the structure, stability and application efficiency of a number of multicomponent disperse systems. Important, in my opinion, are the following results related to industrially significant foam and emulsion systems:

3a. Analysis of adsorption kinetics in mixed solutions of non-ionic block copolymers and sodium caseinate protein shows a direct relationship with the stability of dynamic foams. It has been experimentally established that the volume of dynamic foam decreases above the turbidity temperature of the block copolymer when a heterogeneous foam breaking mechanism is carried out. Block copolymers act as dynamic antifoaming agents even below the turbidity temperature, but by a homogeneous mechanism (J24.3, G7.5).

3b. Systematic study of the co-adsorption of bovine serum albumin (BSA) and beta-casein proteins was carried out by analyzing surface tension and expansion rheology as a function of the ratio of the two proteins in parallel adsorption and in sequential adsorption. The thicknesses of thin foam films obtained by parallel and sequential adsorption are characterized and models for the structure of films and adsorption layers are proposed (G8.8).

3c. A systematic physico-chemical approach has been applied to formulate the composition of dispersion systems with applications in cosmetic products and detergents, e.g. stable microcapsules of silicate particles for encapsulation of oils and perfumes (G7.12); saturated micellar phases and of micellar solutions with filamentous micelles for use in washing and cleaning products (G7.16); compositions for cleaning surfaces in the household (G7.13), in institutional cleaning (G9.22, US Patent App.).

The research activity of Assoc. Prof. Marinova is also bound to participation in a number of contracts. A list of 23 projects (since 2011) has been submitted in connection with this competition. Of these, 13 are industrial projects: 1 with Kruess GmbH, Germany (co-leader), 5 with Unilever, England (participant), 3 with Unilever, the Netherlands (participant), 1 with KLK OLEO, Malaysia (participant), 1 S.C. Johnson & Son, Inc, USA, 1 with Dow Corning, 1 with Doverie-Care EAD (head); 6 projects are with the NSF (head – 2, member of the scientific team – 4); 2 with the Center of Competence (BG05M2OP001-1.002-0023, coordinator and deputy head; BG05M2OP001-1.002-0012, Researcher R3, Member of the Implementation Team); 1 with CVP BG05M2OP001-1.001-0008 (member of the implementation team), 1 under project BG-RRP-2.004-0008 SUMMIT (member of the scientific team).

The scientific activity of Dr. Krastanka Marinova is characterized by an original approach to the selection of the studied objects and systems. The selected scientific problems are formulated clearly; the results are obtained through in-depth experimental research and by applying appropriate approaches for interpretation of the scientific results obtained. In many cases, data, compositions and methodologies are also reached, which are relevant to application in industrial practice.

For the most part, the scientific contributions from the candidate's research activity can be defined as proving by new means essential new aspects of existing scientific and applied scientific problems. The new results obtained are essential for science and will undoubtedly serve as a starting point for both future scientific research and industrial applications.

3. Teaching activities

Krastanka Marinova is a lecturer at the Department of Engineering Chemistry and Pharmaceutical Engineering of the Faculty of Chemistry at Sofia University "St. Kliment Ohridski". Kliment Ohridski" since 2003, first as a senior assistant (2003-2006), Asist. Prof. (2006-2009), and since 2010 as an Associate Professor. The attached documents show that the teaching activity of the candidate is diverse. She lectures on four courses for bachelors (Separation Processes in Disperse Systems – Ecochemistry; Programming of Computational Problems in Chemistry – Chemistry and Informatics; Basic Mathematics – for all specialties; Obtaining and characterizing products for hygiene and cosmetics – for all specialties), and four Master's courses (Dispersions in Cosmetics and Household Chemistry – Dispersion Systems in Chemical Technologies; Cosmetic Products as Dispersion Systems – Pharmacy; Formulation of Dispersions for Cosmetics and Household Chemistry – Cosmetics and Household Chemistry; Basic Mathematics for Chemists – Cosmetics and Household Chemistry). Assoc. Prof. Marinova is the head of the Master's program in Cosmetics and Household Chemistry at the Faculty of Chemistry and Household Chemistry. She has been the supervisor and co-supervisor of a total of 25 defended diploma theses for the EQD of Bachelor and Master. Krastanka Marinova has also been a co-supervisor of three successfully defended dissertations for the Doctoral Degree at Sofia University: (Rumyana Stanimirova, 2014; Lydia Dimitrova, 2017; Mihail Georgiev, 2018).

4. Participation in scientific networks and organizations

Assoc. Prof. Marinova has been a participant in 4 COST Actions (CM1101, MP1106, D43, P21). She has been a guest lecturer at the University of Novi Sad, Faculty of Technology (HR-1108-01-1718 (2018)) and at the University of Lodz, Faculty of Chemistry (HR-1108-05-2122 (2022)). She is a member of the Association of Bulgarian Cosmetologists (chairperson since 2017) and of the Bulgarian National Association of Essential Oils, Perfumery and Cosmetics (member of the Control Board 2019-2023 and member of the Management Board - since 2023).

5. Conclusion

In their entirety, the scientific papers and additional materials of Assoc. Prof. Dr. Krastanka Georgieva Marinova characterized her as a highly qualified, established scientist and lecturer in the field of physical chemistry of surfaces and colloidal systems. I believe that the overall scientific development of the candidate so far, the relevance and perspective of the results of her research and applied scientific activity, the nature and quality of her teaching work exceed the requirements for occupying the academic position of "Professor", set out in the Law on the Promotion of Scientific Degrees and Occupation of Academic Positions and the Recommended Criteria for Acquiring Scientific Degrees and Occupying Academic Positions academic positions at Sofia University "St. Kliment Ohridski" for the professional field of "Chemical Sciences". That is why I recommend with full conviction to the Honorable Faculty Council of the Faculty of Chemistry and Pharmacy at Sofia University "St. Kliment Ohridski" to award to Associate Professor Dr. Krastanka Georgieva Marinova, the academic position "Professor" in professional field 4.2. Chemical Sciences (Physical Chemistry – Formulation of Dispersions for Cosmetics and Household Chemistry).

Member of the scientific jury:

Sofia, 04 November 2024 (Prof. Elena Mileva, DSc)