REVIEW

On a competition to occupy academic position of Associate Professor
Higher education area: 4. Natural Sciences, Mathematics, and Informatics
Professional field: 4.2. Chemical Sciences
Scientific specialty: 01.05.16 Chemical Kinetics and Catalysis
Requesting laboratory: Design and Characterization of Catalytic Materials
Thematic area: EPR spectroscopy and quality of life
Announcement: State Gazette No. 77, 1 October 2019
Reviewer: Prof. Veselina Georgieva Gadzheva, DSc
Faculty of Medicine, Trakia University, Stara Zagora, Bulgaria

Chief Assistant Professor Katerina Ivanova Aleksieva, PhD, an employee at Institute of Catalysis (IC) of the Bulgarian Academy of Sciences (BAS), Sofia, is a sole applicant.

Brief biographical and professional data about the applicant

Katerina Ivanova Aleksieva was born on 11th February 1978. In 2001, she graduated from Faculty of Chemistry at St. Kliment Ohridski University of Sofia. During the period 2002–2006, she worked as a research chemist at IC-BAS. In 2007, she enrolled as self-study doctoral student at IC-BAS and received her PhD in 2009. From 2010, she is Research Fellow Second Degree, and since 2011, she holds the academic position of Chief Assistant Professor at IC-BAS.

Throughout her academic career, Katerina Aleksieva has been constantly improving her skills. She has conducted trainings and specializations at universities and laboratories worldwide, from which she received the relevant certificates: (i) scientific visit to foreign university (University of Saarland, Germany) 2003–2004; (ii) one-year scholarship from World Federation of Scientists, 2007–2008; (iii) certificate for participation in lecture course: Modern instrumental methods for characterization of materials; (iv) certificate for participation in lecture course: Materials with environmental focus; and (v) certificate for participation and training: Innovative developments and patent law.

Katerina Aleksieva's scientific interests are related to the field of EPR spectroscopy and quality of life, which is traditional for the requesting laboratory. Her professional experience and competence in this field have led to her involvement in the organization of the International Conference on Electron Magnetic Resonance of Disordered Systems (EMARDIS) in 2003, 2005, 2007, and 2009. She is a member and secretary of the Bulgarian EPR Society and a member of the Bulgarian Catalysis Society.

Evaluation of submitted materials

This competition and its procedure are based on Article 24 of Act for the Development of the Academic Staff in the Republic of Bulgaria, Article 57a of Rules for the Implementation of Act for the Development of the Academic Staff in the Republic of Bulgaria, Article 11 para. 6-9 of Rules on the Terms and Conditions for Acquisition of Academic Degrees and Occupation of Academic Positions at Bulgarian Academy of Sciences, and Article 51 of Rules on the Conditions and Procedures for Acquisition of Academic Degrees and Occupation of Academic Positions at IC-BAS. I received in due course the necessary documents and materials for the competition submitted according to the requirements of Article 19 of aforementioned act. The terms and conditions of the procedure for acquiring an academic position of Associate Professor are complied with and conform to normative documents. Chief Assistant Professor Katerina Ivanova Aleksieva, PhD, is the only candidate participating in the competition.

The set of materials for the competition, submitted by Chief Assistant Professor Katerina Ivanova Aleksieva, is in accordance with Rules for the Terms and Conditions for Acquisition of Academic Degrees and for Occupation of Academic Positions at Bulgarian Academy of Sciences.

The total number of applicant's publications is 32, 26 of which are in impact factor journals. Dr. Katerina Aleksieva has submitted 27 publications for the competition including one review, which are grouped as follows: (i) papers in impact factor journals – 22 issues with total impact factor of 25.498 – 6(Q1), 4(Q2), 7(Q3), and 5(Q4) as distributed by quartiles according to SJR; (ii) publications without impact factor – 5. The candidate is the first author and correspondent author in 11 publications.

The total number of citations noted is 166 (without quotes from all authors). The observed quotes from ISI database (Scopus and Web of Science) on the entries in the competition are 87, the h index being 8 (Scopus).

A list of 29 participations in scientific forums is presented, most of them being national and international. Four of these are oral reports.

A list of 10 participations in research projects is also presented. The applicant is the head of two projects:

(i) Project leader: EPR spectroscopy study of the type and stability of radiation-generated free radicals in gamma-irradiated foods. Comparative studies by the method of DNA electrophoresis, TC-X-1604/06, funded by Bulgarian National Science Fund (2009–2011);

(ii) Manager of budget subsidy project: EPR food analysis, supported by Bulgarian Academy of Sciences.

Compliance with the minimum national science-metric indicators for the academic position of Associate Professor

A reference and supporting material are enclosed according to Appendix No. 1 of Rules on the Terms and Conditions for Acquisition of Academic Degrees and Occupation of Academic Positions at Bulgarian Academy of Sciences for compliance with the minimum requirements of the academy for the scientific and teaching activity of candidates for occupying the academic position of Associate Professor in area 4. Natural Sciences, Mathematics, and Informatics (as of 18.03.2019), professional field 4.2. Chemical Sciences.

Thesis for the award of a doctoral degree

Katerina Aleksieva defended her dissertation on the topic: EPR spectroscopy possibilities for identification of high-energy irradiated food of plant origin, which brings her the required 50 points according to Group 1 indicator.

Monograph work or equivalent publications

Dr. Katerina Aleksieva participates in the competition with an equivalent number of articles for habilitation treatise (7) in impact factor journals referenced and indexed in Web of Science and Scopus: 5(Q1) and 2(Q3) that bring her 155 points for Group 3.

Scientific publications referenced and indexed in Web of Science and Scopus that are not included in the habilitation treatise

The Group 4 indicator includes 20 publications divided by quartiles: 1(Q1), 4(Q2), 5(Q3), and 5(Q4) for which 240 points are received. The publications without impact factor are five.

Citation in national and foreign literature

A list of 87 citations of 10 publications participating in the competition is presented, which bring her 174 points for Group 5.

The science-metric indicators and evidence presented by submitted information for the fulfilment of the minimum national and additional BAS requirements for occupation of academic position of Associate Professor, Area 4. Natural Sciences, Mathematics, and Informatics, Professional field 4.2. Chemical Sciences, shows that Chief Assistant Professor Katerina Ivanova Aleksieva exceeds the required score points according to Appendix 1 of Rules on the Terms and Conditions for Acquisition of Academic Degrees and Occupation of Academic Positions at Bulgarian Academy of Sciences.

Characteristics of the applicant's activities

Evaluation of basic and applied research activities

Radiation treatment as an alternative method of sterilization and prolongation of foodstuffs durability has yet been available since the middle of the last century due to a number of advantages such as: post-final packaging treatment of the product where there is no danger of re-contamination; the taste of the product is preserved; minimal energy consumption, and no environmental pollution. Currently, ten standards are in place within the European Union for distinguishing between irradiated and non-irradiated foods, three of which use the EPR spectroscopy method. Based on numerous studies confirming that irradiated foods are healthy, scientists are focusing their work on improving existing standards, and creating new ones, which is the aim of K. Aleksieva's research.

The works submitted by the applicant for the competition are related to the use of the electron paramagnetic resonance (EPR) spectroscopy method for applied research. This technique is focused on the analysis of foods and drugs exposed to high-energy radiation; adsorption properties of lignocellulosic waste materials relative to metal ions (biosorption); clarification of the oxidation state of paramagnetic ions in some catalytic materials, etc.

To realize this research work K. Aleksieva has accumulated a lot of theoretical knowledge, skills, and competences in the field of chemistry and biochemistry. She has done a huge amount of practical work using modern EPR instrumental technique to study the type and stability of radiation-generated free radicals in gamma-irradiated foods by EPR spectroscopy. The topic is in line with the priorities of Innovation Strategy for Intelligent Specialization 2014–2020 (ISIS): Industry of healthy living and biotechnology, and that is why I consider it up-to-date and relevant.

Scientific contributions

The scientific contributions to the works of Dr. Aleksieva have a fundamental and applied character and can be summarized in the following directions.

1. Identification of gamma-irradiated food products and drugs by EPR spectroscopy.

The applicant works mainly in this area. Some of the papers [3, 4, 6, 8, 12, 19, 21] are presented for a number of articles equivalent to habilitation treatise. The following important points can be deduced from the conducted investigations:

- For the first time, EPR analysis of food has been expanded from dry to fresh testing by applying new pre-sampling procedures to identify fresh fruit (fleshy part) irradiation [3]. The registration of the so-called ‘cellulose-like’ EPR spectrum with the presence of satellite lines in the EPR spectra can be used to identify radiation treatments for fresh fruits. The same sampling procedures were applied to fruit juices, nectars, and concentrated fruit syrups [12]. A complex

spectrum has been recorded consisting of a ‘cellulose-like’ EPR spectrum and a spectrum of added preservatives. An interesting result is that with 100% fruit juices and homemade fresh juices only the ‘cellulose-like’ EPR spectrum is recorded, since no sugar and preservatives are added. Various saccharides have been added to the concentrated syrups, because of which a typical ‘sugar-like’ EPR spectrum due to the generated free radicals in saccharides is recorded and has a different form depending on which saccharide prevails. In this way, fruit juices can be identified not only as irradiated but also distinguished by their fruit content.

The new developments presented are of practical application because they can extend the scope of European standards EN 1787 and EN 13708 for irradiated foods to include fruit juices and syrups.

- For the first time, some types of food have been examined to identify radiation treatments. The study also recommended which part of the fruit could be sampled for analysis. Fresh, air-dehydrated, and lyophilized tomatoes were subjected to EPR analysis [4] as well as air-dehydrated dates, plums, and figs [19]. In the air-dehydrated and lyophilized tomatoes, a ‘carbohydrate spectrum’ is further overlaid on the ‘cellulose-like’ EPR spectrum. The registration of ‘sugar-like’ EPR spectra in the date regardless of which saccharide contributes most to the EPR spectrum or which part of the fruit is subjected to analysis is a sure proof of radiation treatment. For instance in identifying irradiation in air-dehydrated figs, it is recommended that the flesh be sampled because the ‘sugar-like’ EPR spectrum is recorded. The new developments presented are of practical application because they may extend the applicability of Protocol EN 13708 to irradiated dry dates and figs, and Protocol EN 1787 to dried plums.

- For the first time, some types of drugs and excipients used for their tableting have been investigated, which cannot be sterilized by conventional methods due to their thermal sensitivity, in order to identify high-energy radiation. The most commonly used drug excipients in the pharmaceutical industry have been examined by EPR spectroscopy and subjected to radiation [8]. A link between foods of plant origin and medicines was made by EPR analysis of herbal tablets [6]. Of interest are the results showing that the excipients have a great influence on the obtained EPR spectra and they are not characteristic of the herb itself.

Twelve of the candidate's papers [1, 2, 5, 7, 9, 11, 13, 16, 18, 24, 26, 27] are an extension to the contribution of the habilitation treatise and included in this area. Of interest are the results of the combined application of lyophilization as a gamma-ray sterilization method. Lyophilized forest fruits [9], goji berries [24], tomatoes [7], cereals, hazelnuts, and peanuts [26], etc. were studied.

The results reported clearly show that the oxidation state of manganese and iron in tomato different parts is independent of the fertilizer used. For tomatoes, it has also been found that the oxidation state of manganese in the stems, leaves, and fruit is Mn^{2+}, and that of iron is Fe^{3+}. The presence of characteristic EPR spectra of cereal samples can be used to identify prior radiation treatments and many others.

2. EPR study of lignocellulosic waste materials as biosorbents of metals for water purification

The work of the second direction includes the more important results related to the use of the EPR spectroscopy method for determining the oxidation and coordination state of paramagnetic ions in the studied materials. Five of the works [10, 15, 17, 22, 25] are included in this area. The adsorption of Cu^{2+} ions from samples of hydrolysed lignin and alkaline-treated hydrolysed lignin obtained from wheat straw and maize stalks has been investigated. The adsorption of Mn^{2+} ions in hydrolysed lignocellulosic materials and alkali-treated hydrolysed

lignin obtained from paulownia, straw, and maize stalks. Ag^+ was investigated for its adsorption properties in lignocellulosic materials derived from willow, paulownia, straw, and maize stalks, white poplar, and white acacia.

The main conclusion for the scientific contributions in this area is the possibility of EPR spectroscopy to determine the oxidation and coordination state of paramagnetic ions in biological materials, which is important for their application in practice as biosorbents.

3. EPR determination of oxidation state of paramagnetic ions in catalytic materials

The work involved in the third strand is related to the use of the EPR method in the field of catalysis, which is a relatively new topic for the laboratory. There are three works in this area. Monometallic Co/Al_2O_3 and Pd/Al_2O_3, and bimetallic $Pd\text{-}Co/Al_2O_3$ catalysts have been studied to characterize the oxidation state of palladium and cobalt [14]. Two-phase CuO-NiO solid samples were synthesized using mechanical activation and thermal treatment at different temperatures of 400, 500, 600, and 700°C [20] to investigate their catalytic activity in oxidation reactions. The catalytic activity of lanthana and ceria supported on γ-alumina with respect to the direct decomposition of nitric oxide was studied [23].

The main conclusion of the scientific contributions in this field is the possibility of EPR spectroscopy to determine the oxidation and coordination state of the paramagnetic ions in the catalysts, which is important to explain their catalytic activity.

Teaching activity

It is apparent from the evidence presented that Dr. Katerina Aleksieva conducted exercises in electronic paramagnetic resonance in front of the target group of project BG051PO001-3.3.06-0050: Creation of highly qualified specialists in modern environmental materials: from design to innovation (September-October 2013). She gave a lecture to Saudi Basic Industries Corporation entitled ESR in catalysis (2nd July 2010).

Assessment of the applicant's personal contribution

I believe that the results obtained and their contributions are largely a credit to Chief Assistant Professor Katerina Aleksieva. The reason for this is the fact that she is the first author in 11 of the publications, all these being submitted to the competition. He is the head of two projects one of which is funded by Bulgarian National Science Fund. The high citation of publications is also an indicator of appreciation of her significant personal contribution.

Critical comments and recommendations

I have some remarks regarding the teaching activity of Dr. Katerina Aleksieva, which I consider insufficient, although it is not required according to the criteria for occupying the academic position of Associate Professor according to Rules on the Terms and Conditions for Acquisition of Academic Degrees and Occupation of Academic Positions at Bulgarian Academy of Sciences. Given K. Aleksieva's professional experience and competence, I am convinced that she will be a useful teacher for any university.

Personal impressions

I know the work of the EPR laboratory at IC-BAS and its founder, Professor Nikola Yordanov, one of the designers of the first Bulgarian EPR spectrometer. I am also pleased and highly appreciate the scientific achievements of his followers. I know K. Aleksieva from his team from our joint work on a project supported by Bulgarian National Science Fund: A comprehensive approach to assess changes in biologically active substances and the antioxidant potential of irradiated plant foods and herbs. New gamma-ray protectors (DN19/14, 2017–2020). During the past period since project launch, she actively and effectively collaborated

with participants from different institutions to carry out a large part of the planned joint experimental work. I believe that through her professional experience and competence she contributes to enhancing the credibility of the laboratory at national and international level.

Conclusion

The documents and materials presented by the sole candidate in the competition Chief Assistant Professor Katerina Aleksieva meet all the requirements of Act for the Development of the Academic Staff in the Republic of Bulgaria, Rules for the Implementation of Act for the Development of the Academic Staff in the Republic of Bulgaria, and Rules on the Terms and Conditions for Acquisition of Academic Degrees and Occupation of Academic Positions at Bulgarian Academy of Sciences.

Concerning scientific activity Dr. Katerina Aleksieva has submitted a sufficient number of scientific papers published after the materials used for the defence of her doctoral thesis. She shows a great deal of scientific activity with the publications presented that exceed national requirements, exceeds the requirements for the number of citations, which indicates that the research results published by the candidate have been evaluated and recognized internationally. The applicant's works have original scientific and applied contributions that have received international recognition as a representative part of them have been published in prestigious international journals.

With regard to professional development, Chief Assistant Professor Katerina Aleksieva has an undoubted scientific qualification. She is a scientist using advanced analytical techniques who collaborates actively with researchers from various institutions and universities.

Being aware of the materials and scientific works presented in the competition, analysis of their importance, and scientific and applied contributions contained therein, I find it justifiable to give my positive assessment and to recommend to the Scientific Jury to prepare a report proposal to the Scientific Council of Institute of Catalysis of the Bulgarian Academy of Sciences to award to Chief Assistant Professor Katerina Aleksieva, PhD, the academic position of Associate Professor in professional field: 4.2. Chemical Sciences and scientific specialty Chemical Kinetics and Catalysis.

18.01.2020 Signature:

(Veselina Gadzheva)