

REVIEW

to occupy the academic position:

"Professor"	
"Associate Professor"	X
	one of the academic positions indicated shall be marked with the sign "X"

Candidates to occupy the position:

1	Senior Assist.-Prof.	Dr.	Vanya	Dimitrova	Lilova	UCTM-Sofia
№	academic position	scientific degree	name	middle name	last name	workplace

Scientific area:

4	Natural Sciences, Mathematics and Informatics
code	name

Professional area:

4.1	Physical Sciences
code	name

Scientific specialty:

Structure, Mechanical and Thermal Properties of Condensed Matter

The competition has been announced:

108	22.12.2020	Department of Physics	Faculty of Chemical Technology
in SG issue	date	for the needs of the Department	Faculty

The review was written by:

Assoc. Prof.	Dr.	Ruzha	Georgieva	Harizanova	UCTM
academic position	scientific degree	name	middle name	last name	workplace

1. Review for the candidate:

Senior Assist.-Prof.	Dr.	Vanya	Dimitrova	Lilova
academic position	scientific degree	name	middle name	last name

1.1. Completion of the provided documents:

A) The competition documents are in full compliance with the	3 points	X
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Regulations		
B) The documents are complete but do not fully comply with the requirements of the Regulations	2 points	
C) The documents are not completed in accordance with the requirements of the Regulations	0 points	
		one of the answers given is marked with the sign "X"

Missing documents and violated requirements must be described if response C is marked.

The documents submitted for the competition are in full compliance with the requirements of the Law for the Development of the Academic Staff in the Republic of Bulgaria (LDASRB) and the Regulations for the application of LDASRB at the UCTM.

1.2. Meeting the minimum requirements under the Regulations:

A) The candidate meets the minimum requirements	20 points	X
B) The candidate doesn't meet the minimum requirements	0 points	
		one of the answers given is marked with the sign "X"

It must be filled in if answer B is marked. The publication activity of the candidate is analyzed. The response of the results achieved (quoted) is analyzed.

In the competition for the academic position "Associate Professor", Dr. Vanya Lilova applies with 21 scientific works in total which are published in referred and indexed journals and books. 10 of the submitted articles substitute for the habilitation thesis (indicator 4 from the Law for the Development of the Academic Staff in the Republic of Bulgaria (LDASRB) and the Regulations for the application of LDASRB at the UCTM), the rest of them – 11 in total are as follows: 8 correspond to indicator 7 and 3 are chapters in edited books, corresponding to indicator 11.

During the last 5 years, the candidate has taken part in 16 international and national conferences. She participated in the Organizing committee of 3 international scientific conferences.

A list with the co-authored practical tuition manuals (2) and textbooks (1) – criteria 22 and 23 – has been submitted. A list is supplied with the participation in 16 and coordination of 5 - in total 21 scientific projects with the BNSF/ Bulgarian Ministry of Education and the Scientific sector of UCTM, according to indicators 14 and 16.

Dr. Lilova was appointed to deliver lectures in two courses and has co-authored the preparation of 3 teaching programs for the educational degree Bachelor and 2 programs – for the educational degree Master, as well as she has reviewed 4 Master theses of students from the UCTM.

From the obligatory **400 points** for the occupation of the academic position "Associate Professor" in the professional direction 4.1 Physical sciences, according to the Regulations for the application of LDASRB at the UCTM, Dr. Lilova applies in the competition with materials, corresponding to **488 points**.

1.3. Relevance of scientific and / or applied research:

A) The research is relevant. Part of the research is pioneering (no results are known on the topic by other authors)	7 points	X
B) Research is relevant. Results from other authors are known for	5 points	

each of the topics and / or applications studied.		
C) Most of the research is relevant, but also some results are presented that have no scientific and / or applied value	3 points	
D) The smaller part of the research is relevant	2 points	
E) Research is not relevant	0 points	
		one of the answers given is marked with the sign "X"

The evaluation of the relevance of the research must be substantiated.
<p>The areas of scientific interests of Dr. Lilova are up to date and of both fundamental and applied importance. They could be outlined as follows:</p> <ol style="list-style-type: none"> 1. Synthesis and characterization of composite materials based on a borate matrix. 2. Study of the anodic behaviour of zinc. 3. Preparation and investigation of bulk and thin film chalcogenide materials. 4. Thin films optical properties investigation. <p>The scientific works submitted for the competition are undoubtedly up to date and contribute to the expanding of the variety of advanced oxide and chalcogenide glassy and glass-ceramic materials. They also complement the existing information, concerning the structure, physical properties and optical characteristics of the thin chalcogenide and azopolymer films which contributes to the elucidation of their potential applicability as optical recording and information storage media.</p> <p>There is gathered and summarized valuable information concerning the kinetics and thermodynamics of phase separation in multi-component oxide glasses and glass-ceramics with optical, magnetic and electro-optic properties and potential for application in optoelectronics, medicine and sensor technologies.</p> <p>The kinetics of thin zinc film formation has been investigated in case of varying initial synthesis conditions. Investigation of the structure and the main parameters of the obtained thin films and characterization of their anodic behaviour has been carried out. Very high forming voltage values varying from 100 to 350 V, depending on the anodizing conditions, have been achieved and the existence of induction periods in the kinetic curves has been established.</p>

1.4. Knowledge of the problems subject of research:

A) The candidate knows in detail the achievements of other authors on the researched topics and/or applications	6 points	X
B) The candidate is partially familiar with the achieved results on the researched topics and / or applications	4 points	
C) The candidate has no prior knowledge of the status of the researched problems	0 points	
		one of the answers given is marked with the sign "X"

The evaluation must be substantiated if answer C is marked.
The presented list of contributions undoubtedly shows that the candidate is familiar with the scientific problems in all the presented investigation topics. The submitted works demonstrate her ability to skillfully combine the already existing experimental data with those acquired in her research, so that

conclusions could be drawn that contribute to the expanding of the knowledge in the respective scientific areas.

1.5. Type of research:

A) Theoretical	4 points	
B) Applied	4 points	
C) Theoretical with application elements	4 points	X
D) It does not correspond to the level specified in the Act for the Development of the Academic Staff in the Republic of Bulgaria and the Regulations	0 points	
		one of the answers given is marked with the sign "X"

The level of research must be substantiated if answer D is marked.

The research work of Senior Assist-Prof. Vanya Lilova concerns the synthesis of new advanced oxide and chalcogenide bulk and thin film materials aiming their application in optoelectronics, sensor technologies and medicine. The selected large number of experimental methods for the characterization of the phase composition, the structure and the physico-chemical and optical properties of the obtained materials allows to gather information which is fundamental by nature, however, also leads to elucidation of the potential practical applicability of the respective materials studied by Dr. Lilova.

1.6. Objectives of the research:

A) Realistic and of scientific and / or applied interest	8 points	X
B) Realistic, but not of scientific and / or applied interest	4 points	
C) Unattainable (unrealistic)	0 points	
		one of the answers given is marked with the sign "X"

Objectives must be specified. The type of the set objectives must be justified.

The objectives in the research activities of Dr. Lilova are of both fundamental and applied importance and could be summarized within the frames of the different areas of her scientific interests, as follows:

1. **Synthesis and characterization of composite materials based on a borate matrix.**

The main goals of the investigations carried out in this area could be summarized as follows: selection of appropriate matrix compositions for the synthesis of nanocomposites in the system $\text{PbO-B}_2\text{O}_3$ with and without the addition of MoO_2 by using different synthesis techniques – high temperature synthesis from a melt; sol-gel and solid-phase synthesis and investigation of the phase composition and structure of the samples obtained in this system; studying of the structural evolution and phase formation in the systems $\text{TeO}_2\text{-B}_2\text{O}_3\text{-Fe}_2\text{O}_3$, $\text{TeO}_2\text{-B}_2\text{O}_3\text{-MnO}$ and $\text{TeO}_2\text{-B}_2\text{O}_3\text{-MnO-Fe}_2\text{O}_3$ envisaging the selection of compositions showing phase separation in which subsequently nanosized composite materials with advanced optical and magnetic properties will be obtained; in the system $30\text{B}_2\text{O}_3\text{-}60\text{TeO}_2\text{-}10\text{Fe}_2\text{O}_3$ 10 wt.% ferromagnetic nanoparticles of Fe_3O_4 , CoFe_2O_4 and CuFe_2O_4 have been added aiming to trace the structural evolution of the matrix and of the obtained composites depending on the velocity of cooling in the cases with or without the application of external magnetic field.

2. Study of the anodic behaviour of zinc.

The main objective of this type of research activities of the applicant is to study the anode behaviour of zinc in case of different thin film synthesis conditions aiming to determine the kinetics of film growth and the phase formation peculiarities and microstructure of the obtained materials.

3. Preparation and investigation of bulk and thin film chalcogenide materials.

In this direction of scientific research of Dr. Lilova, the goals concern the synthesis of bulk materials in the $(\text{GeSe}_5)_{100-x}\text{In}_x$, $(\text{GeTe}_5)_{100-x}\text{In}_x$ and $(\text{GeTe}_4)_{100-x}\text{Cu}_x$, for $0 < x < 20$ mol % by utilizing the melt-quenching technique; determining of their physico-chemical properties (density, compactness, molar volume, free volume, number of bonds per atom and average energy of the bonds); elucidation of the structural transformations occurring as a function of the changing composition and in how far they correspond to the predictions of the already existing theories for the structure of the chalcogenide materials.

Thin films have been obtained from synthesized chalcogenide bulk materials utilizing the vacuum thermal evaporation method in the systems $(\text{GeTe}_3)_{100-x}\text{In}_x$ and $(\text{GeTe}_4)_{100-x}\text{In}_x$, $x = 5, 10, 15$ and 20 mol % aiming to establish the influence of the substrate used on the composition of the obtained films.

In the thin films from pure Se, from the binary system Ge-Se and from the ternary systems Ge-Se-Ga and Ge-Se-In holographic recording has been successfully performed using a standard interferometric technique, in order to determine the diffraction efficiency value and to trace the photo-induced changes in the microstructure of the respective materials occurring during the optical recording.

The possibilities have been explored to obtain homogenous crystalline thin films from thermoelectric materials in the chalcogenide system $\text{Bi}_2(\text{Se}_{1-x}\text{Te}_x)_3$ by means of laser pulsed deposition, thus, aiming to establish their phase composition and morphological characteristics and how these features of the films influence the optical properties of the obtained materials in respect of their potential application as parts of the construction of optical recording devices.

4. Thin films optical properties investigation.

Thin Sb films have been obtained by vacuum thermal evaporation on a glass substrate and subsequent anodizing in solutions of oxalic acid with different concentrations has been performed, aiming to trace the influence of the increasing electrolyte concentration on the width of the measured optical band gap.

Investigations have been carried out on the composite layers of the azopolymer PAZO, doped with metal-organic complexes of Cu and Ni, aiming to establish the influence of the metal particles' concentration on the ability for photo-induced birefringence and on the optical properties.

Thin films of the type $\text{Si-SiO}_2\text{-In}_2\text{O}_3\text{:As}$ have been synthesized by utilizing the spray pyrolysis technique envisaging to trace the influence of As as a dopant on their resistance and optical characteristics in the visible and infrared range of the electromagnetic spectrum with regard to a potential application as parts of position-sensitive detectors.

1.7. Methods of research:

A) Adequate to research and set scientific objectives and /or applications	8 points	X
B) Partially appropriate, enabling part of the scientific objectives and / or applications to be achieved	4 points	
C) Inappropriate methods	0 points	
		one of the answers given is marked with the sign "X"

Methods must be specified. The type of methods used is justified.

In the scientific works presented in the competition for the occupation of the academic position "Associate Professor", a large number of traditional and modern physical and physico-chemical

methods has been selected and used for the synthesis and in order to gather information on the phase composition, structure, electrical and optical properties of the obtained glassy, glass-crystalline bulk and thin film materials. The syntheses have been carried out by using the melt-quenching method, sol-gel method, different types of solid-phase synthesis, vacuum thermal evaporation, laser pulsed deposition and spray pyrolysis. The investigation of the phase composition and the structure has been performed by X-ray diffraction, X-ray photoelectron spectroscopy, IR- and Raman spectroscopy, AFM, EM (SEM and TEM), and the elemental composition has been studied by using energy dispersive X-ray spectroscopy and the inductively coupled plasma method.

1.8. Candidate research contributions:

A) With lasting scientific and / or applied response, they form the basis for new research and applications	20 points	
B) They are of significant scientific and / or applied interest, complete and / or summarize previous research	16 points	X
C) They are of scientific and / or applied interest	12 points	
D) Lack of significant contributions	8 points	
E) Lack of contributions	0 points	
		one of the answers given is marked with the sign "X"

Contributions must be specified. The type of results achieved must be justified.

The main scientific contributions in the investigations of the applicant are of both fundamental and applied interest and could be summarized in the different research areas as follows::

1. Synthesis and characterization of composite materials based on a borate matrix (publications 4.1, 4.3, 4.8, 7.1, 7.2 и 11.1).

Selection of compositions suitable for the obtaining of nanosized composites in lead-borate matrices by using various synthesis techniques – traditional high-temperature synthesis, sol-gel method and different modifications of the solid-phase synthesis. Valuable information has been gathered regarding the structure, phase composition and transport, as well as the optical properties of the synthesized composites in respect of their potential application in optoelectronics and electronics. Investigation and establishment of the glass-forming ranges and phase-separation mechanisms in the studied oxide systems, as well as to which extent the presence of microheterogeneities in the respective glass-like materials will influence the phase formation and the physical properties. Magnetic anisotropy occurrence has been observed as a result from the cooling down of the obtained phase-separated glass-like materials in an external magnetic field.

2. Study of the anodic behaviour of zinc (publications 7.6, 7.7 и 7.8).

The formation mechanisms and the growth kinetics of thin anodic zinc films obtained by applying different initial conditions have been studied. The existence of induction period in the formation of the films has been established, as well as extremely high forming voltage values have been achieved. Hypotheses have been raised concerning the mechanism of formation and growth of the thin layers. Their phase composition and surface morphology have been elucidated. A comparative analysis has been performed between the results obtained in the present work and the results from other authors, as well as in the case of metals different from zinc. Information has been gathered regarding the structure of the obtained films by means of IR- and X-ray photoelectron spectroscopy.

3. Preparation and investigation of bulk and thin film chalcogenide materials (publications 4.4, 4.7, 7.3, 7.4 и 7.5).

Bulk and thin film amorphous and glass-crystalline materials have been obtained in the chalcogenide systems Ge-Se-In, Ge-Te-In, Ge-Te-Cu, Se and Ge-Se-Ga in a broad compositional range. A

thorough investigation of the phase composition, the structure and the physico-chemical characteristics of the obtained specimens has been performed and hypotheses have been raised for the applicability of the existing theories about the structure of the chalcogenide glasses and its evolution in dependence of the changing composition to the studied materials. Data are gathered for the morphology of the obtained thin films and their structure. The optical properties have been studied and the change in the diffraction efficiency as a dependence on the composition in the systems Ge-Se-Ga and Ge-Se-In has been traced and the compositions for which its value is maximal are found - $(\text{GeSe}_5)_{85}\text{Ga}_{15}$ and $(\text{GeSe}_5)_{85}\text{In}_{15}$.

Another significant contribution in the scientific work of Dr. Lilova is the establishing of the possibilities for the synthesis of materials which have potential as topological insulators in the system $\text{Bi}_2(\text{Se}_{1-x}\text{Te}_x)_3$ by using the laser pulsed deposition technique, as well as the characterization of the structure and the phase composition of the obtained thin crystalline films with regard to their potential for application as parts of the construction of optical recording devices..

4. Thin films optical properties investigation (publications 4.5, 4.6, 4.9 и 11.2).

Thin Sb films have successfully been synthesized on a glass substrate by vacuum thermal evaporation and subjected to anodizing in oxalic acid solutions with various concentrations. The influence of the oxalic acid changing concentration on the measured optical band gap width of the thin films has been established.

Research has been carried out aiming the preparation of composite thin films based on the PAZO azopolymer, doped with metal-organic complexes of Cu and Ni with different concentrations. An increase in the maximum photo-induced birefringence with the increasing metal particle concentration has been established

A successful attempt for the synthesis of thin film structures of the type $\text{Si-SiO}_2\text{-In}_2\text{O}_3\text{:As}$ by using spray pyrolysis has been made. The influence of the doping by As on the electrical resistance and the optical transmittance in the visible and infrared range of the electromagnetic spectrum has been established. A hypothesis has been raised that the prepared thin films have potential for application in the construction of position-sensitive detectors whose operation is based on the lateral photoelectric effect.

1.9. Participation of the candidate in the achievement of the presented results:

A) The candidate has at least an equal participation in the submitted papers	8 points	
B) The candidate has at least an equal participation in most of the submitted papers	7 points	X
C) The candidate has a secondary participation in most of the submitted papers	4 points	
D) The candidate participation is unnoticeable	0 points	
		one of the answers given is marked with the sign "X"

Critical notes must be provided if one of the items C or D is marked.

Dr. Vanya Lilova applies in the competition for the occupation of the academic position "Associate Professor" for the needs of the Department of Physics at the UCTM with 21 scientific works in total, 10 of which substitute for the habilitation thesis (indicator 4) and the rest of the publications correspond to indicators 7 and 11, as determined by the Law for the Development of the Academic Staff in the Republic of Bulgaria (LDASRB) and the Regulations for the application of LDASRB at the UCTM. The applicant's contribution to the publications submitted in the competition is undisputable and equal as participation which is supported by her leading or significant part in the preparation of most of the 21 papers - in 3 of them she is the first author, in 7 – the second one and in 4 papers she is third author. In 4 of the publications she is the corresponding author.

1.10. Pedagogical activity:

A) The candidate has effective and sufficient pedagogical activity at the university. The textbooks issued are modern and useful (they meet the requirements of the Regulations). The work with undergraduate and doctoral students is at a high professional level.	8 points	X
B) The candidate has sufficient pedagogical activity at the university. The textbooks issued satisfy the requirements of the Regulations.	6 points	
C) The pedagogical activity and / or textbooks issued are insufficient (do not meet the requirements of the Regulations)	0 points	
		one of the answers given is marked with the sign "X"

Critical notes must be provided if one of the items B or C is marked.

Dr. Lilova has a long-term teaching activity at the UCTM (from 1995 till present) and has been supervising the practical courses in General Physics, Biophysics and Solid State Physics for the students from the Bachelor degree of different specialties at the UCTM. During the last 5 years she has been appointed to deliver lectures in the subjects "Introductory Course in Physics" for the Bachelor degree and "Methods for Microstructural Characterization of Materials (taught in English)" for the students from the Master degree and visiting Erasmus students.

As a result of her long-term and diverse as subject matter teaching activity and her pedagogical experience, Senior Assist-Prof. Vanya Lilova has become the co-author of two Manuals for Practical Exercises in Physics and 1 textbook – "Physics – Introductory Course".

She has co-authored the preparation of 3 teaching programs for the Bachelor degree: "Physics (Medical Physics)", "Biophysics" and "Physical Methods for Microstructural Characterization of Materials" and 2 teaching programs: "Methods for Microstructural Characterizations of Materials (taught in English)" and "Explosion Physics" - for the Master degree.

She has consulted 4 diploma students – 2 from the Bachelor degree and 2 from the Master degree and has reviewed 4 Master theses of students from the UCTM.

1.11. Critical notes:

A) Lack of critical notes	8 points	X
B) Critical notes of a technical nature	7 points	
C) Critical notes that would partially improve the results achieved in a small part of the research	5 points	
D) Critical notes that would partially improve the results achieved in most of the research	3 points	
E) Significant critical notes	0 points	
		one of the answers given is marked with the sign "X"

Critical notes must be provided if one of the answers C, D or E is marked.

I have no critical comments/remarks regarding the documents submitted by Dr. Vanya Lilova in the competition for the academic position "Associate Professor".

1.12. Conclusion

A) The evaluation of the candidate's activity is POSITIVE	This evaluation is assigned to a total number of at least 65 points	X
B) The evaluation of the candidate's activity is NEGATIVE	This evaluation is assigned to a total number below 65 points	
		one of the answers given is marked with the sign "X"

To be filled in if requested by the reviewer

The materials submitted in the competition allow me with conviction to give a positive evaluation of the research and pedagogical activities of the candidate because they correspond to and for some indicators exceeds the minimum requirements determined in the Law for the Development of the Academic Staff in the Republic of Bulgaria (LDASRB) and the Regulations for the application of LDASRB at the UCTM.

Based on the stated above and due to my positive personal impressions of the candidate, I would recommend

Senior Assist.- Prof. Dr. Vanya Dimitrova Lilova

to be appointed at the academic position "Associate Professor" in the professional area 4.1. Physical sciences and scientific specialty „Structure, mechanical and thermal properties of condensed matter“ at the Department of Physics at UCTM.

29.03.2021	The review was written by:	
date		signature