

REVIEW

on the materials submitted by Senior Assist. Professor, PhD Yavor Mitrev from IOHCF-BAS for participation in the competition for the academic position of Associate Professor at the Institute of Organic Chemistry with Centre for Phytochemistry (IOCP), BAS in the field of higher education "Chemical Sciences", professional field - 4.2, scientific specialty "Organic Chemistry" for the needs of laboratory "Centre of NMR spectroscopy", announced in the State Gazette, issue 37 of 17.05.2022 and on the Internet page of IOCCF, BAS

Reviewer: Associate Professor, PhD Bozhanka Paskaleva Mikhova, associate member of IOCCF, BAS, appointed with an order of the Director of IOCCF No PD-09-95/14-07-2022.

Dr. Yavor Mitrev presented all required documents which are in accordance with the Act for the Development of the Academic Staff in the Republic of Bulgaria (ADASRB), the Regulations for the application of the ADASRB, the Regulations for the terms and conditions for acquiring academic degrees and occupying academic positions of the Bulgarian Academy of Sciences and the Regulations for the terms and conditions for acquiring academic degrees and occupying academic positions of the IOCCP-BAS, related to the procedure for occupying the academic position "Associate Professor".

The documentation submitted has been prepared correctly and in accordance with all requirements and recommendations.

I. Personal and professional data of the applicant

Dr. Yavor Mitrev was born on 25. May 1982. In Vratza. He Graduated from Natural Mathematics High School with intensive learning of foreign languages. He completed his higher education at the Faculty of Chemistry and Pharmacy (FCP) of Sofia University "St. Kl. Ohridski". In 2012 he obtained a Bachelor's degree in Organic chemistry and in 2013 a Master's degree in "Methods for synthesis and analysis of organic compounds with application of NMR spectroscopy" under the supervision of Prof. Dr. S. Simova

In 2007 - 2011 Dr. Yavor Mitrev was a regular graduate at the Faculty of Chemistry with supervisor Prof. Mariana Palamareva and scientific consultant Dr. Milen Bogdanov. He defended his PhD thesis on "Synthesis, purification and analysis of organic compounds. Examination and demonstration of mechanisms of reactions".

Dr. Yavor Mitrev continues his scientific career at the IOHCF-BAS: as a chemist (2005), Assistant Prof.(appointed in 2010) and Senoir Assist, Prof. (in 2012) at the laboratory ‘‘Centre of NMR spectroscopy’’

During the period 2014 – 2015 he completed a postdoctoral specialization at the University of Geneva, Switzerland under the supervision of Dr. Damien Jeannerat on the subject ‘Development of new experiments for NMR spectroscopy’.

2. Scientific contributions

All publications Dr. Mitrev are presented in reputable international journals. The acceptance of these publications in them is in line with the high value of the scientific results achieved.

The total number of publications is 24. With 16 of them Dr. Mitrev participates in the competition. In three of the publications presented, Dr. Mitrev is first author. He is a sole author of one publication.

The reading of the papers gives enough reason to assume that Mr. Mitrev has substantial merit for the success of the experiments, for the generalization of the results and writing the publications.

The distribution by indicators is as follows: indicator A - 50 points; indicator C - 112 points; indicator D - 227 points; indicator E - 194 points; and Hirsch index 6.

As can be clearly seen, the applicant's contributions fully cover the national requirements. The extended habilitation report is based on 16 original scientific publications, covering the last nine years since Dr. Mitrev's appointment to the Senior Assistant position. Eleven of the sixteen scientific communications are published in journals of the highest category Q1. The report about the scientific contributions is written concisely and clearly. In my opinion, these works fit well the profile of the competition. The achieved results, with which the candidate participates in the competition, are divided into three areas.

A.Applied and methodological NMR investigations

The section covers 3 publications. The research in the first two was carried out as part of the postdoctoral specialization at the University of Geneva and in the third - completely in the ‘‘Centre of NMR spectroscopy’’, IOCCF, BAS with Dr. Mitrev as a sole author.

A.1. Discrimination of hexabromocyclododecane from new polymeric brominated flame retardant in polystyrene foam by nuclear magnetic resonance//

The main objective of the study was quantitative evaluation of Hexabromocyclododecane (*HBCD*), widely used as a flame retardant in polystyrene insulation materials. This is achieved with the help of

heterocorrelation and techniques for filtering the signals of macromolecules based on their shorter spin-spin relaxation times (the so-called T₂ filter). As a result, a rapid NMR method was developed to distinguish *HBCD* from flame retardants based on bromine-containing polymers

The common in the following two publications is the use of slice-selective experiments. The slice-selective NMR spectroscopy is an innovative approach enabling spectral information to be received from a discrete part of the sample.

A.2. NMR analysis of weak molecular interactions using slice-selective experiments via study of concentration gradients in agar gels.

A methodology for obtaining NMR titration data in water was developed. As a result, an analytical technique, alternative to the conventional NMR titration in water, with the possibility of parallel analysis of a large number of samples in fully automated mode was developed. Further use of spatially selective one-dimensional experiments allows the recording of spectra from different regions of the NMR sample, thus affording calculation of the complexation parameters after mathematical treatment.

A.3. Spatially selective NMR spectroscopy for investigation of distribution phenomena in two-phase systems.

In this research, the examination of the possibilities of applying the spatially selective NMR spectroscopy to the study of distribution phenomena in two-phase systems was achieved. The distribution of vanillin in a D₂O/CDCl₃ system was used as a model system. The presence of two solvents with different magnetic susceptibilities required a change in the standard NMR impulse experiment as well as the development of new programs for accelerated recording of spectra in the interleaved acquisition mode, which is of critical importance when the sample composition changes quickly with time.

B Application of solid-state NMR spectroscopy for structural investigations of new mesoporous materials.

The presented investigations were conducted at the Bulgarian NMR Centre, together with Prof. Pavleta Shestakova and are summarized in 2 publications.

B.1 NMR investigation of functionalized MCM-48 and SBA-15 silicates as potential CO₂ capture and storage materials

MCM-48 and SBA-15 silicas, modified with morpholine and 1-methylpiperazine were investigated by solid state NMR, aiming at structural characterization of the new materials, as well as comparative study of their CO₂ adsorption. The silicate matrix of the newly obtained materials was characterized using solid state ²⁹Si cross-polarization transfer experiments and ¹³C NMR techniques. In summary, 4 new materials were characterized by solid-state NMR spectroscopy and their mechanism of carbon dioxide adsorption was investigated.

B.2. Investigation of modified beta-type nanosized mesoporous silicas with potential application as catalysts for the production of phenol from lignin biomass

In the following investigation, the aluminosilicate matrix of 5 new materials, based on zeolite type beta, modified with Ni, Pt, Ru, and combinations thereof, was characterized using solid state NMR spectra of ^{29}Si и ^{27}Al . As a result, the aluminosilicate matrix of zeolite type beta was characterized, along with the changes it undergoes when modified with Ni, Ru and Pt

C. Application of NMR spectroscopy in solution for structural elucidation and study of molecular mobility of organic compounds

The research in this section covers eleven publications required by criterion "G" according to the Law for the Development of Academic Staff in the Republic of Bulgaria and was carried out in the Bulgarian NMR Centre, with the exception of one publication, the measurements of which were carried out at the University of Geneva.

C1. As a part of the collaboration with a research group from Southwestern University "St. Neofit Rilski", a series of amino acids and substituted cinnamic acids amides with three adamantane derivatives was studied. Due to relatively scarce literature data, a more in-depth NMR investigation for the amantadine and rimantadine derivatives was conducted, including systematic assignment of proton and carbon chemical shifts, and in the case of rimantadine products, which were isolated as diastereomeric mixtures, qualitative analysis of Nuclear Overhauser Effects.

The results are presented in four publications.

C.2. In collaboration with the group of Assoc. Prof. Mantareva from the IOCCP, NMR studies aimed at proving the structure of newly obtained zinc phthalocyanine dyes were carried out. The main difficulty in this case was the low concentration at which the NMR analysis was carried out, due to aggregation of the phthalocyanines in dimethylsulfoxide, as well as the limited solubility in other organic solvents. Using various techniques for solvent suppression, one-dimensional proton NMR spectra were recorded, which, in combination with the significantly more sensitive MS spectrometry, were sufficient to confirm the structure of the target compounds.

The results are summarized in two publications.

C.3. With NMR spectroscopy is determined the configuration of the double bond in chalcone and trisubstituted polyhydroxy stilbenes. The results are presented in two publications.

C.4. Together with the theoretical chemistry group at the Faculty of Chemistry and Pharmacy, a theoretical and NMR study was carried out, aiming at determination of the tautomeric composition of folic acid at physiological conditions.

The results are summarized in one publication

C.5. The common in the following two works is the use of Diffusion NMR spectroscopy.

In collaboration with an international team of scientists, mixtures of glycerol with dimethylsulfoxide in various ratios were investigated. For this purpose, the diffusion coefficients of a series of samples were measured, which, in agreement with the results of other techniques, showed that in the studied concentration interval the mixtures between glycerol and dimethylsulfoxide behave as a relatively homogeneous solvent, without concentration-dependent effects on their physical properties, except for density and the ability to form hydrogen bonds.

In another study, data from diffusion NMR spectroscopy were used to explain the influence of choline chloride and dibutylhydroxytoluene on the stability of 5-hydroxymethyl furfural (*5-HMF*).

The study of the works gives sufficient reason to accept that the Dr. Mitrev has substantial merit for the success of the experiments, for the generalization of the results and their summarising in publications.

3.Participation in scientific forums

Dr. Yavor Mitrev presented a list of sixteen participations in scientific forums, of which 5 were oral presentations and the rest – posters. Eleven of his participations are at scientific forums abroad. Four oral presentations and five posters are on the subject slice-selective NMR spectroscopy. The results presented in his participation in scientific forums are the basis of the published works from the list.

4.Participation in scientific projects

Dr. Mitrev participated in seven scientific projects funded by BAS, the Fond of Scientific research and European programs. His substantial personal involvement especially in the part of NMR spectroscopy is beyond doubt.

5. Citations

As

I have already noted, the citations presented in this competition are 97. This is much more than the recommended requirements. All of Dr. Mitrev's works are cited in reputable international journals, except for two cited in doctor's thesis.

6. Personal impressions

My personal impressions of Dr. Yavor Mitrev, accumulated in the process of working together in the NMR group are excellent. This applies both to his promising scientific contributions and to

his ability to work in a team and participate in scientific and organizational activities in the laboratory and institute.

I would like to point out that his master's work and doctoral dissertation are related to methods of synthesis and analysis of organic compounds, which contributes to his growth as a specialist with versatile skills.

In addition to the described scientific contributions, Dr. Mitrev's participation in maintaining the available spectrometers and performing service analysis should be noted, which is by no means an easy task and requires a lot of knowledge and its continuous improvement.

7. Conclusion

The own contribution to the research and the acquired scientific competence of Senior Assist. Prof. Dr. Yavor Mitrev are undoubted. The fields in which Dr. Mitrev's scientific interests are presented have great scientific potential and can contribute to his further development as a successful scientist. The availability of appropriate NMR spectrometers at IOCCP, BAS makes this possible and will allow Dr. Mitrev to be useful for the scientific research at IOH.

The documents and materials, presented by Senior Assist. Prof. Dr. Yavor Mitrev comply with all the requirements of the Law for the Development of Academic Staff in the Republic of Bulgaria, the Regulations for the Implementation of the Law, the Regulations for the Implementation of the Law at BAS and the Regulations of the IOHCF-BAS.

After evaluating the materials and scientific works presented in the competition I confidently recommend to the other members of the Scientific Jury to prepare a report-proposal to the Scientific Council of IOCCP for conferment of the academic position "Associate Professor" of Dr. Yavor Mitrev in professional field 4.2. "Chemical Sciences", scientific specialty "Bioorganic Chemistry, Chemistry of Natural and Physiologically Active Substances".

11.09.22

Reviewer:

Associate. Prof. Dr. Bozhanka Mikhova, IOCCP, BAS