# REVIEW

by Prof. PhD Eng. Angel Antonov Dikov

of the materials submitted for participation in the competition
for the academic position of „Associate Professor”
at University of Plovdiv "Paisii Hilendarski"

scientific area 5. Technical sciences,
professional field 5.1. Mechanical Engineering,
speciality "Technology of Mechanical Engineering"

In the competition for "Associate Professor", announced in the State Gazette, issue 57 of June 26, 2020 and on the website of Paisii Hilendarski University of Plovdiv for the needs of the Department of Mechanical Engineering and Transport at the Faculty of Physics and Technology, as a candidate participates Ch. Assist. Prof. PhD. Eng. Velko Slavchev Rupetsov from the Faculty of Physics and Technology.

**1. General presentation of the received materials**

By Order № P33-4124 of 24.08.2020 of the Rector of Paisii Hilendarski University of Plovdiv /PU/ I was appointed a member of the scientific jury of a competition for the academic position of "Associate Professor" in PU in the field of higher education 5. Technical sciences, professional field 5.1 Mechanical engineering (Technology of Mechanical Engineering), announced for the needs of the Department of Mechanical Engineering and Transport at the Faculty of Physics and Technology.

Only a candidate has submitted documents for participation in the announced competition is Ch. Assist. Prof. PhD. Eng. Velko Slavchev Rupetsov from Paisii Hilendarski University of Plovdiv, Faculty of Physics and Technology, Department of Mechanical Engineering and Transport.

Presented by Ch. Assist. Prof. PhD. Eng. Velko Slavchev Rupetsov a set of paper materials is in accordance with the Regulations for the development of the academic staff of the University of Plovdiv and includes the following documents: application form to the Rector for admission to the competition; curriculum vitae; higher education diploma with a master's degree; diploma for educational and scientific degree "doctor"; list of scientific works; reference for compliance with the minimum national requirements; annotations of the materials under Art. 65 of RDASPU, including self-assessment of contributions; declaration of originality and authenticity of the attached documents; certificate of work experience; documents for educational work; research documents; other documents.

The applicant Ch. Assist. Prof. PhD. Eng. Velko Slavchev Rupetsov has submitted a total of 32 scientific papers: 1 individual monographic work, 1 book based on a dissertation, 1 university textbook (with one co-author), 1 manual for laboratory exercises (with one co-author), 1 textbook (with one co-author) and 27 scientific publications.

I accept for review 27 scientific publications that are outside the dissertation and take into account in the final evaluation 4 textbooks and 5 research projects. The distribution of scientific papers by respective headings, in the country and abroad, is as follows: 20 - in the country, 7 abroad. Documents (in the form of official notes) for participation in scientific forums and for applied in

practice results of scientific research in Arexim Engineering EAD, the company "Ella" - Smolyan and in the FTF of PU "Paisii Hilendarski" for scientific research and teaching activities, as well as their benefits.

**2. Brief biographical data of the candidate**

Velko Slavchev Rupetsov was born in Smolyan in 1965. He graduated from Angel Kanchev University of Ruse, specialty "Complex mechanization and production lines in mechanical engineering", additional specialization "Robotics, robotic systems and FAMS". He started working at the Institute of Mechanical Engineering and Transport in Smolyan in 1991 as a constructive engineer and organizer of teaching and production activities, then worked as an assistant and a chief assistant.

In 1999 the Technical College moved to Plovdiv University "Paisii Hilendarski", and Eng. Velko Rupetsov took the place of Chief Assistant in the Department of Mechanical Engineering and Transport of the Technical College of Smolyan, Paisii Hilendarski University of Plovdiv. He defended his doctoral dissertation on ""Increasing of the wear resistance of parts and tools for production equipment in the food industry" in 2015. From 2015 until today he is a chief assistant doctor at Paisii Hilendarski University of Plovdiv, Faculty of Physics and Technology, Department of Mechanical Engineering and transport.

**3. General characteristics of the candidate's activity**

*Assessment of the educational and pedagogical activity*

The educational and pedagogical activity of Ch. Assist. Prof. PhD. Eng. Rupetsov dates back to 1995. He participated in the educational process in 1 master's and 2 bachelor's specialities. His classroom employment in the last five years is 2388 hours. During this period he conducted classes in 14 disciplines: Mechanical engineering technology I and II part, Metal cutting machines and equipment, Machine elements, Computer design of parts and assemblies of the machine building production, Automated preparation of technical documentation, Nanotechnologies in the machine building - CVD and PVD processes, Computer design of machines, processes and systems, etc. In 6 of the disciplines the candidate conducts lectures and laboratory exercises, in 1 - lectures, and in the remaining - laboratory and seminar exercises. He was a lecturer at the Polytechnic University - Bucharest under the Erasmus+ program. He is the author of the curricula for 22 disciplines and a participant in the development of curricula. The candidate has published: textbook "Technology of Mechanical Engineering, Technological Processes for processing of standard parts and assembly of products" (with one co-author); Manual for laboratory exercises in mechanical engineering technology, part one (with one co-author), Notebook collection of exercises in engineering graphics (with one co-author) and is the author of an e-course on "Automated development of technical documentation with AutoCAD". Ch. Assist. Prof. PhD. Eng. Rupetsov was the supervisor of 32 graduates and reviewed the works of 33 graduates. He is the supervisor of two Erasmus+ students and is the academic mentor of 6 students in the Student Internships program. There are two publications involving students.

All this gives me reason to assume that the candidate has the necessary teaching experience and pedagogical skills to work with students.

*Evaluation of the scientific and scientific-applied activity of the candidate*

The candidate has submitted for participation in the competition for associate professor the following works:

3.1. An individual monographic work "Increasing in the Durability of Machine Parts and Tools by Coating Deposition" published in 2020 by Paisii Hilendarski University Publishing House,

Plovdiv with ISBN 978-619-202-560-1- B.3. The monograph is 128 pages long and was reviewed by Prof. DSc Georgi Mishev and Assoc. Prof. PhD Ruslan Dikov.

3.2. A book "Increasing the wear resistance of parts and tools of production equipment" based on a defended dissertation for graduation of educational and scientific degree Doctor /136 pages long/ - Г.6. The book was published by ZEA-Print Ltd., Smolyan in 2018 with ISBN 978-619-196-073-6 and was reviewed by Prof. DSc Stefan Petrov Dichev and Prof. PhD Stefan Vasilev Stefanov.

3.3. A university textbook "Mechanical Engineering Technology, Technological Processes for the Processing of Types of Parts and Assembly of Products" with one co-author and is 196 pages long. It was published by ZEA-Print Ltd., Smolyan in 2019 with ISBN 978-619-196-083-5. The textbook was reviewed by Assoc. Prof. PhD Stanislav Aleksiev.

3.4. University schoolbooks, 2 items:

- A Manual for Laboratory Exercises in Mechanical Engineering Technology, Part One, it was published by ZEA-Print Ltd., Smolyan in 2016 with ISBN 978-619-196-037-8. The manual is co-authored with 1 author and was reviewed by Prof. DSc Georgi Atanasov Mishev.
- Exercises in Engineering Graphics (Workbook). It was published by Book Boutique Publishing House - Sofia in 2016. The workbook is co-authored with 1 author and is 62 pages long, having ISBN 978-954-92755-0-6.

The 27 scientific publications presented in the competition are:

- 7 scientific publications (from Г.7.1 to Г.7.7.) in issues which are referenced and indexed in world-famous databases of scientific information (with impact factor).
- 20 scientific publications in non-refereed journals with scientific review from Г.7.8 to Г.7.27

The candidate participates in the competition with a total of 32 papers.

I do not accept 5 papers for review as follows:

- A publication mentioned in point 3.1: I mark but do not review it – 1 item;
- A publication mentioned in point 3.2: I mark but do not review it – 1 item;
- A publication mentioned in point 3.3: I mark but do not review it – 1 item;
- Publications mentioned in point 3.4: I mark but do not review it – 2 items.

I accept 27 papers for reviewing.

The applicant's participation in the reviewed papers is as follows:

- Individual author of 4 works (Г.8.8, Г.8.9, Г8.10, Г.8.27);
- First author of 8 works (Г.7.1, Г.7.6, Г.7.7, Г.8.20, Г.8.21, Г.8.22, Г.8.24, Г.8.26);
- Second author of 6 works (Г.8.12, Г.8.14, Г.8.16, Г.8.17, Г.8.18, Г.8.23);
- Third author of 6 works (Г.7.2, Г.8.11, Г.8.13, Г.8.15, Г.8.19, Г.8.25);
- Fifth author of 1 paper (Г.7.5), sixth author of 1 paper (Г.7.3) and seventh author of 1 paper (Г.7.4).

Of these works, 11 are in Bulgarian, 15 in English and 1 in Russian. All works are in the field of competition.

The publications of Ch. Assist. Prof. PhD. Eng. Rupetsov could be classified in the following areas:

- Improving the tribological properties of the products by wear-resistant coatings deposition (B.3, Г.6, Г.7.1, Г.7.2, Г.7.3, Г.7.4, Г.7.6, Г.7.7, Г.8.20, Г.8.22 and others);

- Creation of innovative and nanolaminate coatings by Closed Field Unbalanced Magnetron Sputtering (CFUBMS) technology (Г.8.6, Г.8.7, Г.8.18, Г.8.19);
- Rheological studies of cooling lubricants (Г.7.5, Г.8.25);
- Design and manufacture of equipment and research equipment (Г.8.8, Г.8.9, Г.8.10, Г.8.24, Г.8.26);

In the period from 2014 to 2020, Ch. Assist. Prof. PhD. Eng. Velko Rupetsov has participated in 5 projects (three university, one faculty and one national of the Ministry of Education and Science).

*Contributions (scientific, scientific-applied, applied) and citations*

The contributions in the works of the candidate are classified into three groups:

**I. Scientific contributions** (formulation or substantiation of a new scientific problem; creation of new classifications, research methods, new constructions and technologies).

- A technology for deposition of multilayer CrN / TiN coatings at temperatures below 200 ° C has been developed and their mechanical and tribological properties depending on the main technological parameters have been studied (3).

**II. Practical scientific contributions** (obtaining and proving of new facts and creation of new classifications, methods, constructions, technologies, schemes; proving with new means of essential new aspects of already existing scientific fields).

- It has been developed and proven that for multi-component coatings such as CrTiAlN and TiCrAlN, those based on Cr possess better mechanical properties than coatings based on Ti - higher hardness (≤ 31GPa) and higher scratch resistance (> 30N) It has been studied influence of the parameters of the CFUBMS process on the properties of the coatings (4);
- It has been proven that the nanocomposite coating Ti/TiN/TiCrN-ml deposited on steel 1.2767, increases the wear resistance as follows: for unhardened ground surfaces 6 - 8 times; for hardened ground surfaces 10 - 13 times; for hardened polished surfaces 50 - 60 times (18).
- One nanolaminate coating Ti/TiN/AlTiSiN/(AlTiSiN/TiAlSiN)n/AlTiSiN has been created and its mechanical properties have been investigated and its practical application for cutting tools has been proven (6).
- The innovative nanolaminate Ti/TiN/TiCrCN/(CrCN/TiCN)n hard coating deposited by CFUMS has been proven to be suitable for metal-ceramic (cermet) cutting tools used for precise high speed machining (HSM) of aluminum alloys (7).
- One wear model based on the principle of physical modeling has been proposed, using the cybernetic approach (the "black box" principle) (11).
- One methodology for experimental determination of tangential contact deformations under static load of the support has been proposed. The influence of the main technological parameters of the metal-cutting machines on the tangential contact deformations, respectively on the friction force, has been experimentally determined and the corresponding quantitative dependences have been derived (13).
- It has been shown that the specific wear intensity Iw has a relatively constant value which depends mainly on the quality of the surfaces and not on the conditions of their loading recommending that the most responsible elements of the injection molds be hardened and polished before the coating deposition (18, 20).
- It has been proved that during the deposition of the multilayer coating Ti / TiN / CrN-ml and the nanocomposite coating Ti / TiN / TiCN / nc-TiCN: a-C / ncTiC: a-C / a-C by the method of

unbalanced magnetron sputtering (UBMS ) the initial roughness of the surface on which the coating is deposited does not change (1, 20, 22, 27).

- The main factors influencing the accuracy of positioning of the systems for rectilinear motion in the production equipment are determined. An equation is derived to determine the maximum positioning error (accuracy) (23).
- A multimedia interactive computer model has been created, providing work with static and dynamic images, including animation and text (16).
- The correlation dependencies of the wear rate on the normal force, sliding speed and friction path for the multilayer coating Ti/TiN/CrN-ml deposited on a hardened ground surface of 37Cr4 steel are derived (22). It has been proven that the greatest influence on the wear rate is exerted by the normal force, and the least - by the friction path.

**III. Practical contributions**

- Based on the conducted research it has been proposed that the profile curve of the shaft of the band saw blades flattening machine KL 160 to be made using an Archimedean spiral (9).
- One protective assembly has been designed which moves with the upper belt-guide and covers the working part of the belt above the log. A prototype of the assembly for ББ 110 has been made, as the proposed model could be implemented in all types of block band saws and dividing band saws, which have a mechanized movement of the upper belt-guide (10).
- One CC-1 stand has been designed and manufactured which reproduces the kinematic scheme of work of the elements of the piston-cylinder group (PCG). The stand serves to determine the influence of the test parameters on the technical condition of the PCG elements (11).
- One universal milling machine FNC 25E3 has been constructively changed and its technological capabilities for processing of rotary profile surfaces by milling have been expanded respectively (8).
- A technological process for repair of defective elements of a differential mechanism has been proposed (17)
- The rheological properties of different types of Cooling Lubricating Fluids (CLF) as a function of their chemical and physical characteristics have been evaluated experimentally and recommendations for their application have been given (5, 25).
- For the evaluation of the thickness of thin hard coatings, one calo tester has been designed and manufactured which is used in both the educational process and scientific research (24).
- The main tribological characteristics of multilayer coating Ti/TiN/CrN-ml (21), nanocomposite coating Ti/TiN/TiCN/nc-TiCN:a-C/nc-TiC:a-C/a-C (1) and gradient nanocomposite coating nc-$(Al_{1-x}Ti_x)N$/a-$Si_3N_4$ (2) have been studied.
- A software module for visualization of an involute gearing has been created which allows its realistic understanding (16).
- One equipment for combined coating formation using Electric Arc Deposition (EAD) and Magnetron Sputtering (MS) has been designed and manufactured, with which various nanostructured coatings with suitable industrial properties could be deposited (19).

*Citations*

There are 24 presented citations of papers, distributed as follows:

- In scientific issues which are refereed and indexed in notable databases of scientific information or in monographs and collective volumes – 3 items. (Д.12.1, Д.12.2, Д.12.3);

- In monographs and collective volumes with scientific review – 20 items. (Д.13.1 до Д.13.20).
- In non-refereed journals with scientific review- 1 items. (Д.14.1).

*Implementation activity*

Official notes and certificates for applied in practice results of research in Arexim Engineering EAD, the company "Ella" - Smolyan and in the FTF of PU "Paisii Hilendarski" for research and teaching activities, as well as their benefits.

**4. Evaluation of the personal contribution of the candidate**

From the analysis of the presented scientific works of the candidate it can be seen that there are significant scientific, scientific-applied and applied contributions in the field of the announced competition in "Technology of Mechanical Engineering". A database of theoretical and practical information about the structure, physical-mechanical and tribological properties of the developed coatings has been created. To study the durability and thickness of thin hard coatings, stands have been designed and methodologies have been created, which have been implemented in teaching and research.

From the presented materials it can be seen that the scientific activity of the candidate is known to the scientific community in Bulgaria and abroad. In addition, over 15% of the submitted works are independent, in over 30% the candidate is in first place and in about 22% he is in second place. This gives me reason to assume that for the most part the contributions are his personal work or were received through his decisive participation.

The presence of 24 citations of the candidate's works by Bulgarian and foreign authors shows the recognition of the candidate by the scientific community in Bulgaria and abroad.

The quantitative indicators of the criteria for holding the academic position of "Associate Professor" are fulfilled.

**5. Critical remarks and recommendations**

In the submitted scientific works of the candidate there are notes of secondary importance, which do not have a significant impact on the evaluation of his work, for example:

1. It is not shown which of the features of nanolaminate and nanocomposite coatings makes them suitable for deposition on tools.
2. In the research very few studies have been done on the structure of the coatings and the main attention is paid to their mechanical properties.

**6. Personal impressions**

I know Ch. Assist. Prof. PhD. Eng. Velko Slavchev Rupetsov personally, because a few years ago I was lecturing at the Technical College in Smolyan. From these contacts, from the presented materials and from his participation in conferences and seminars, I got an impression of his competence and awareness. I believe that he has established himself as a qualified specialist and can be characterized as a recognized researcher and educator in the field of Technology of Mechanical Engineering, in particular in the field of tribology and coatings.

## CONCLUSION

The documents and materials submitted by Ch. Assist. Prof. PhD. Eng. Velko Slavchev Rupetsov meet all the requirements of the Law for the Development of the Academic Staff in the Republic of Bulgaria (LDASRB), the Regulations for implementation of LDASRB and the respective Regulations of Paisii Hilendarski University of Plovdiv.

The candidate in the competition has submitted a sufficient number of scientific papers published after the materials used in the defense of educational qualification degree „Doctor“. In the works of the candidate there are original scientific and applied contributions, which have received international recognition as a representative part of them are published in journals and scientific journals published by international academic publishers. His theoretical developments have practical applicability, as some of them are directly oriented to the educational work. The scientific and teaching qualification of Ch. Assist. Prof. PhD. Velko Rupetsov is undoubted.

After getting acquainted with the materials and scientific papers presented in the competition, the analysis of their significance and the scientific, scientific-applied and applied contributions contained in them, I find it reasonable to give my positive assessment and recommend the Scientific Jury to prepare a report-proposal to the Faculty Council of Faculty of Physics and Technology to choose Ch. Assist. Prof. PhD. Eng. Velko Slavchev Rupetsov for the academic position "Associate Professor" at the University of Plovdiv "Paisii Hilendarski” in the professional field 5.1. Mechanical Engineering, specialty "Technology of Mechanical Engineering".

20. 10. 2020
Sofia

REVIEWER: .....
(Prof. PhD Eng. Angel Dikov)