Review of the doctoral (PhD) dissertation titled

Investigation of New Composition CVD Coating Formulations in Terms of Mechanical Properties and Cutting Efficiency

by Osamah Ihsan Ali

Reviewer: István Biró, PhD, Department of Manufacturing Science and Engineering, Budapest University of Technology and Economics

General overview

The dissertation comprises a total of 136 pages, out of which 96 pages compose the body text (i.e. the PhD work's leading content and merits). The remaining pages stand for the document's front matter (title and copyright page; abstract; list of content, tables, figures, symbols, and abbreviations; acknowledgement) and the back matter (bibliography, appendices). The body text is structured into nine leading sections, one of them specifically dedicated to the new scientific statements.

An impressive number of 150 independent sources are listed in the bibliography. 42 (28%) of the referred source documents originate from the past 5 years (2020-2024), indicating that the PhD work synthesises up-to-date information. Referred sources include scientific papers, books, and industrial standards as well. The oldest referred source is from 1969, showing the PhD work's aim to connect the classical and new technical knowledge in favour of the covered topic's fundamental understanding.

I would change the dissertation's title by identifying TiN- and TiC-based hard coatings as the work's subject. The title in the current state implies that a more general scope of CVD coatings has been addressed, although the covered content is more specific. Additionally, I find the term "investigation" to be too general. The research is about developing a more stable and resilient hard coating, which fact should be emphasised in the title. However, I understand and accept the fact that the title cannot be changed after starting the official PhD recognition procedure.

The dissertation proves the PhD candidate's ability to uphold and maintain scientific research work precision on detailed facts, carry out experiments and measurements with great care, and make solid conclusions based on the acquired data.

A fact to be appreciated is that the dissertation has been improved significantly since the home defence, based on the comments and suggestions.

Remarks on the technical content

Section 1 primarily states the aim and goals of the research at the beginning of the section, which helps the reader to have an overall concept of the topic.

Section 2 comprises the literature review, which provides a solid background of the research work. The manufacturing process of CVD coatings, including a deep understanding of the occurring chemical processes, is addressed in detail. Section 2's structuring shows the clear logic of how the information obtained during the literature review was understood and evaluated. References are listed and marked accurately.

Section 3 discusses the direct objectives of the experiments. This section can be regarded as the follow-up of the previously suggested new Introduction, as Section 2 already concerns the more specified, focused, and technical aims. Figure 25 is an interesting and informative presentation of the topic's keywords, their timely and quantitative distribution and their connection in the reviewed literature sources; thus, Figure 25 prepares and supports the objectives listed later.

Section 4 concerns the testing and evaluation methods and the equipment. The applied testing and measurement equipment are identified in-text, and pictures of the equipment are to be found in Appendix B. As stated, the tests and measurements were conducted at the Research Centre of Engineering Sciences, Department of Materials Engineering, University of Pannonia.

Sections 5 and 6 are about explaining and discussing the measured data and results. These sections prove how complex the research work was and that the PhD candidate acquired the experience and knowledge to conduct research in the future on his own. These are the most valuable and most complex parts of the dissertation. Tables, graphs, and microscope shots present the results of the tests and measurements in detail. I highlight the vast amount of visual and mechanical material testing, all of which follow the standardised protocols and contribute significantly to the research's final statements.

Section 7 summarises the final conclusions in a detailed manner. This is a very important section since it summarises the information resulting in the creation of new scientific statements later.

Section 8 is dedicated to the new scientific statements. **Section 9** is about who the research may be continues in the future.

Remarks on the document's format and layout

The body text has a generally consequential and well-organised formatting. Below, I list some remarks about details not affecting the work's understandability or scientific content, but may affect the overall appearance and impression. Objects (figures, tables, equations, appendices, etc.) are precisely referred to in the body text. Markings (units, references, object numbering, etc.) are applied consistently. Literature references contain direct ID (ISBN, DOI, etc.) where available, helping the sources' identification.

Five new scientific statements have been formed, all of them I accept.

Conclusion

The dissertation presents complex research on the applicability of CVD hard coatings and the development of more resilient coatings in the same category. A solid and comprehensive literature review supports the experiments and the conclusions. The results and statements are valuable additions to the state-of-the-art knowledge about CVD hard coatings.

I recommend accepting the PhD-thesis.

Questions

1. Statement 1 says that zirconium is preferred as a counter material for TiN and TiC coatings. What applications requiring CVD hard coatings could benefit from this observation, and how?
2. How can the coating's thickness affect a cutting tool's cutting ability?
3. Regarding the diagrams: What is the reason (i.e. scientific meaning) of data points being directly connected by higher-order functions (see Fig. 41, 42 and 46) or straight lines (see Fig. 54 and 55)?

Budapest, 12 June, 2025

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