Review Report on PhD Thesis

Faculty: **Central European Institute of Technology** Academic year: **2024/2025**
Brno University of Technology in Brno

Student: **Ing. Tomáš Krajňák**

Doctoral study program: **Advanced Materials and Nanosciences**

Supervisor: **prof. Ing. Jan Čechal, Ph.D.**

Reviewer: **Mgr. Eliška Materna Mikmeková, Ph.D.**

PhD thesis title: Structure of tricarboxylic acids on metal surfaces

Topicality of doctoral thesis:

The dissertation focuses on the current issue of molecular self-assembly of tricarboxylic acids on metal surfaces, an area of fundamental importance both for basic research in surface physics and for potential applications in organic electronics and nanotechnology. The topic is well situated within the contemporary context of global research.

Meeting the goals set:

The objectives of the thesis were clearly defined, and the author fulfilled them in their entirety. The candidate systematically progressed from the preparation and characterization of metal substrates to a detailed study of organic layers and their phase transformations. He demonstrated the ability to independently plan and carry out complex experiments, interpret the results, and draw scientifically relevant conclusions.

Problem solving and dissertation results:

The thesis presents original and published results on the structure, stability, and transformations of tricarboxylic acid layers on silver surfaces. Particular emphasis should be placed on the experimental complexity of the entire study. The author worked under ultra-high vacuum conditions and successfully carried out the preparation of clean metal substrates, the deposition of organic molecules, and their characterization using complementary methods—low-energy electron microscopy, X-ray photoelectron spectroscopy, and scanning tunneling microscopy. These techniques require a high level of expertise and technical skill and represent a comprehensive experimental approach that is non-trivial. The candidate demonstrated the ability not only to conduct such demanding experiments but also to interpret their results and formulate broader scientific conclusions.

Importance for practice or development of the discipline:

The findings obtained have significant value for the advancement of the field. They contribute to a better understanding of the mechanisms behind the formation and stability of organic layers and their use as interlayers in organic electronics. It can be expected that these results will find applications in the design of new functional surfaces and, in the long term, in applied areas such as sensors or next-generation electronic devices.

Formal adjustment of the thesis and language level:

The thesis is carefully prepared in terms of formal aspects; the text is logically structured and supplemented with clear figures and graphs. The language level is very good—comprehensible and fluent. Citations are correctly presented, and the bibliography is complete. The author's publication output demonstrates his active involvement in the international scientific community.

(4) The study is duly completed by a state doctoral examination and the defense of a dissertation, which proves the ability and readiness for independent activity in research or development or for independent theoretical and creative artistic activity. The dissertation must include original and published results or results accepted for publication.)

Questions and comments:

In the author's view, in which direction should the follow-up research proceed, and which phenomena does he consider the most important for further study?

Among the methods used—which proved to be the most sensitive and most beneficial for addressing the given issues, and how does the author assess their limitations?

Conclusion:

The dissertation Structure of Tricarboxylic Acids on Metal Surfaces fully meets the formal and substantive requirements set forth for doctoral theses according to the applicable regulations. Throughout the work, the author has convincingly demonstrated the capability to conduct independent and original scientific research. He has successfully mastered a range of highly demanding and technically complex experimental procedures conducted under ultra-high vacuum conditions, including the preparation of clean metal substrates, the deposition of organic molecules, and their detailed characterization using complementary advanced techniques.

The results obtained represent a significant and original contribution to the fields of surface physics and organic electronics, providing new insights into the structure, stability, and phase transformations of tricarboxylic acid layers on metal surfaces. These findings not only deepen the fundamental understanding of molecular self-assembly processes but also have potential implications for the design of functional materials in nanotechnology and organic electronic devices.

Overall, the dissertation reflects a high level of scientific rigor, methodological skill, and analytical competence. The author has demonstrated the ability to interpret complex experimental data critically and to formulate scientifically relevant conclusions, thus making a valuable contribution to the advancement of the discipline.

In my opinion, the reviewed thesis fulfills all requirements posed on theses aimed for obtaining a PhD degree. This thesis is ready to be defended orally, in front of the respective committee.

In Brno., date 23/08/2025

Mgr. Eliška Materna Mikmeková, Ph.D.