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Dissertation review

The dissertation work of Martin Kovařík focuses on the utilization of scanning probe microscopy for the analysis of low-dimensional structures and devices. This includes graphene grown on metal substrates, characterization of dislocations in GaN, and electrical characterization of WS_2 nanotubes. The thesis reflects a diverse set of activities: Martin contributed to a Horizon Europe research project (GaN-related work), carried out a highly challenging experiment involving WS_2, which also included theoretical modeling, and—last but not least—conducted numerous exploratory experiments to support other ongoing research within our group.

It must be emphasized that the dissertation topic was very demanding, as it required performing complex experiments that rely on in-depth knowledge of the instrumentation involved. Martin employed several different microscopes in his work, ranging from a standard commercial scanning probe microscope (Bruker), a unique Nanoscan tool, to the Litescope, which he used extensively for the most technically challenging experiments. A hidden aspect of Martin's experimental contribution was his effort to demonstrate previously unachievable measurements. The use of the Litescope proved to be the most difficult; therefore, only partial success was achieved (e.g., in graphene grain boundary characterization). The main obstacle in these experiments was beyond Martin's control: the availability of reliable tips. Nevertheless, he produced meaningful results that aligned with our ongoing research projects. Similarly, the GaN work represents a specific research task conducted in collaboration with an industrial partner (Infineon Austria). It is only thanks to Martin's almost heroic effort that, after two years, we were able to develop a robust methodology for the characterization of line defects in production GaN wafers. Finally, the operando electrical measurements on WS_2 nanotubes serve as an excellent example of independent research carried out by Martin as a stand-alone project, resulting in a first-author publication.

Martin has always been a reliable and responsible member of our group. He was very active and supportive in mentoring junior students, effectively assisting them in their research. He also prepared a short course for high school students and continuously taught basic physics courses at the faculty throughout his Ph.D. studies. He independently secured an internship at the Max Planck Institute in Düsseldorf, demonstrating his initiative and motivation to broaden his research experience. He consistently sought new research challenges and directions.

In my opinion, Martin Kovařík is a mature researcher capable of identifying and solving original research problems. I fully support his graduation and strongly recommend awarding him the Ph.D. degree.

Sincerely,

Miroslav Kolíbal