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CZECH TECHNICAL UNIVERSITY IN PRAGUE

Faculty of Biomedical Engineering

Department of Biomedical Technology

Supervisor's evaluation of Doctoral thesis:

Marie Krečmarová

DESIGN AND REALIZATION OF THE PRINCIPLE OF LABEL FREE DETECTION OF DNA MOLECULES USING NV CENTRE QUANTUM ELECTRON TRANSITIONS IN DIAMOND NANOSENSOR

The thesis of Ing. Marie Kracmarova deals with a hot topic of developing label-free optical sensors for monitoring of biomedical reactions. These work has been executed in the framework of Erasmus exchange between the FMBE CTU and the University Hasselt. Part of this work was also executed at the Institute of Physics, Czech Academy of Sciences. The studied devices were based on NV quantum centres in diamond. The central idea of the thesis was to combine quantum state readout of a NV diamond device reacting on changes in its close biomolecular environment with an electrochemical device. By setting up a specific electrochemical potential on the device the quantum detector can be locked upon specific chemical reactions that can be then monitored by NV sensor.

After designing the sensor Marie started her work at the Institute of Physics, Czech Academy of Sciences under the supervision of Dr. V. Mortet. The first part of her work concerned developing of B-doped diamond films that can be used for electrochemical device principles. This work has been executed by Marie fully independently and let to publications in peer-review journals. Later on she was developing quantum sensors and working on their characterization by using the confocal setup at FBMI and UHasselt. She has also developed mathematical modeling of the device function, including its readout by luminescence. In the final stage of her work, Marie constructed a microfluidic device at UHasselt, measured its electrochemical characteristics and optimized NV centre PL readout to demonstrate the idea of simultaneously using electrochemical and quantum readout on the same device. She then used DNA functionalization to test the developed device for DNA sensing.

The experimental results acquired were part of publications which she authored or co-authored and the last publication of the sensor function is being submitted. Marie's work was selected as oral presentation at several international conferences such as e-MRS in Warsaw.

Marie is an enthusiastic and extremely hard working student, excellent team worker and a help to colleagues. Although her original background was related to art field (ballet), based on her interests she has completed education at FBMI with interests to Physics. She has my full credit for selecting this not trivial topic of quantum sensing.

The PhD thesis assembles high level multidisciplinary scientific work. The developed techniques have a large potential for biomedical applications. Marie has tackled this thesis by an amazing way as the majority of works, except some minor specialized measurements as SEM, were executed by herself. This is the reason why this thesis took full given time as it assembled an enormous amount of independent experimental work, including mathematical modelling.

I strongly recommend Ing. Marie **Krečmarová** thesis for PhD defense and for receiving PhD degree.

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