

Supervisor report on Doctoral Thesis prepared by

Mgr. Fedir Borodavka:

## **PFM and Raman spectroscopy of selected dielectric materials**

Fedir Borodavka started his PhD study at the Department of Dielectrics of the Institute of Physics Czech. Acad. Sci. in January 2009. The topic of his thesis was chosen with the idea to combine Raman spectroscopy and Piezo-Force Microscopy (PFM), using a recently acquired AFM apparatus in our department. This combination is very efficient in the study of domain structure in a broad family of dielectric materials. F. Borodavka has quickly familiarised himself with both techniques and actively participated in their improvement.

The materials studied ranged from a novel crystal for nonlinear optics, monoclinic GUHP (guanylurea hydrogen phosphite), where angular dependences of Raman spectra permitted symmetry assignment of a number of external and internal vibration modes, to BiMnO<sub>3</sub> ceramics, where Raman results indicated that the monoclinic structure is centrosymmetric. In the complex perovskite compound La<sub>1/2</sub>Na<sub>1/2</sub>TiO<sub>3</sub>, the Raman results suggest that the structure is probably identical to the low-temperature phase of SrTiO<sub>3</sub>.

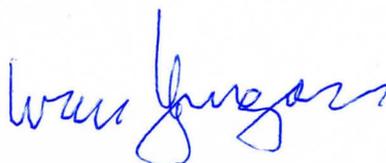
Perhaps the most interesting results come from a combined Raman and AFM/PFM study of ferroelectric PbTiO<sub>3</sub> thin films deposited on several perovskite substrates. Here, the results revealed the differences in the meso- and nanoscopic domain structure due to different misfit and surface conditions, resulting in intricate domain patterns.

During his doctoral studies, F. Borodavka showed his experimental skills and inventive approach. He mastered Raman spectroscopy techniques and proposed several important refinements of the measuring process. Regarding AFM/PFM, he paid much attention to improvement of the technique in order to avoid artefacts and errors due to inappropriate choice of the tip and scanning conditions. This part of the thesis might serve as well as a guide for newcomers, aiding them to overcome the possible pitfalls of the method.

F. Borodavka is the co-author of 11 papers in peer-reviewed Journals (the first author in 2 of them). He actively participated in their preparation. Since 2011, his work has been cited altogether 44 times (i.e. ~9 citations per year), excluding self-citations.

Concluding, I cannot but recommend that the present thesis be accepted for the defense.

In Prague, March 4, 2015



Ing. Ivan Gregora, CSc. (supervisor)

Institute of Physics, Czech Acad. Sci.  
Na Slovance 2, 18221 Praha 8  
Phone: 26605 2654, e-mail: gregora@fzu.cz