

Supervisor report

on doctoral thesis entitled

Time-resolved terahertz spectroscopy applied to investigation of magnetic materials and photonic structures

prepared by **Mgr. Hynek Němec**

This thesis is focused on the investigation of photonic and resonant structures for the terahertz spectral range. The time domain terahertz spectroscopy on one hand and the physics of photonic crystals on the other hand have encountered a considerable development since their invention at the end of 1980s; however, until recently there was a small number of works combining these two topics. The present work covers both theoretical and experimental aspects of the subject and in my opinion it constitutes a significant contribution in this rapidly growing research field.

Referring to about 300 bibliographical references the author covered thoroughly but succinctly the current state-of-the-art of the terahertz spectroscopy (methods of generation and detection of terahertz pulses, spectroscopic methods and goals) and described the fundamental properties of photonic crystals and the methods of their calculations.

The focus of the original part of the work is surely in the investigation of one dimensional Bragg structures with defects. A theoretical part is developed with the aim to design a functional structure serving as an externally controllable spectral filter. A thermally tunable structure based on an incipient ferroelectric (KTaO_3 , SrTiO_3) defect layer has been prepared and its high tunability has been demonstrated. Prospects concerning the electric field induced tunability then constitute a solid basis for future applied research in this field.

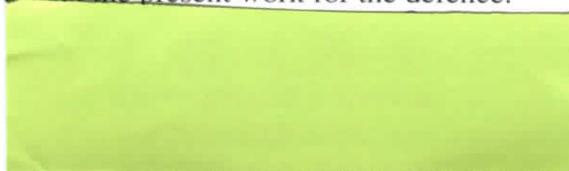
In view of the rapidly developing physics and technology of metamaterials, namely those showing a negative refractive index, the author proposed and experimentally demonstrated several methods for simultaneous characterization of dielectric and magnetic properties of thick (bulk) samples. The results were also applied to a "computer simulated" all-dielectric metamaterial exhibiting an effective magnetic behavior.

The theoretical concepts developed by the author were also successfully applied to the investigation of a planar grating coupler. The author found a quantitative interpretation of the observed resonant phenomena recently reported in the literature and determined a band structure of this element.

During his doctoral studies Mr. Němec has clearly shown that he is skilled not only to perform excellent quality scientific work, but that he is also able to present his results on the international level. He is the first author of 11 publications in peer reviewed prestigious journals (*J. Chem. Phys.*, *J. Opt. Soc. Am. B*, *Opt. Lett.*, etc), he was asked to give a invited talk at the International Conference on Coherent and Nonlinear Optics in 2005 and his very first work (H. Němec et al., *J. Appl. Phys.*, **90**, p. 1303, 2001) has been quoted 22 times according to the citation index.

In summary, I strongly recommend to accept the present work for the defence.

In Prague, February 22, 2006



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