SUMMARY

„Study of photonic nano- and microstructures fabricated using focused ion beam technology"

Focused ion beam (FIB) technology was developed in the 1970s and 1980s. During the interaction of the beam with matter, physical sputtering occurs using high-energy ions. The possibility of micromachining on the nanometer scale is used in materials engineering for the analysis of new materials, in electronics for the prototyping of complex electronic circuits, in photonics for the fabrication of various types of optical structures, including photonic crystals, and in biology for the analysis of properly prepared preparations.

The Ph.D. dissertation concentrates on the use of focused ion beam technology as a tool for prototyping photonic structures for jewelry applications. The dissertation is aimed at on photonic crystals, which are designed to obtain, by reflection, as many colored light reflections from the crystal as possible. FIB technology allows for relatively fast and precise prototyping of photonic structures but has the disadvantage of ion implantation. The most used ion sources are based on gallium ions: literature sources report that implanted gallium causes uncontrolled absorption in the area of fabricated photonic structures. As a consequence, the fabricated structure may have different optical parameters than planned.
An analysis of scientific literature signaled the possibility of using post-preparation, which would allow either the removal of implanted gallium or its use in the fabrication of structures.

The purpose of the Ph.D. dissertation was to develop a method for fabricating photonic structures using focused ion beam technology that would be free of implanted gallium ions. As part of the research, photonic structures based on an 8-axis symmetry quasi periodic structure were fabricated, which was examined optically and then annealed at high temperatures to remove implanted gallium ions and measured again optically. Repeated measurements were carried out to analyze the effect of annealing on the optical parameters of the fabricated structures. In addition, the study verified the possibility of using implanted gallium ions as a mask in the ICP-RIE process.

The conducted studies confirmed the possibility of producing photonic structures using FIB technology, free of implanted gallium ions.

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Ph.D. student signature