SUMMARY

„Application of photonic crystals for electromagnetic field control in optoelectronic structures"

Photonic crystals (PhC) are periodic dielectrics structures that contain regularly repeating regions of high and low value of refractive index. Depending on the type of periodicity, we distinguish: one-dimensional PhC (e.g. Distributed Bragg reflector, DBR), two-dimensional (e.g. an array of nanocylinders) and three-dimensional (e.g. woodpile structure). The PhCs structures have unique properties: the photonic band-gap, control the amplitude of the radiation and the spectral characteristics of the scattered light. Since the first constructions of photonic crystals (by E. Yablonovitch), the number of applications of PhCs is increasing.

One of the applications of photonic crystals is the new generation anti-reflection coatings. In this case the transmission and reflection properties are used. The advantage of PhC in comparison to classical anti-reflection coating (ARC) is the changing of direction of light propagation. The effect is used in light-trapping structures. The fabricated photonic crystals have a technology-related errors: redeposition of etched materials, stitching, sloped sidewalls or elliptical shape of elements. Some of these can be reduced but not all. The technology-related errors have influence on the distribution of the electromagnetic field in the semiconductor layer and the optical properties of photonic structure.

The aim of the PhD work was to analyse the electromagnetic field distribution in the semiconductor layer, which is created by the radiation passes the photonic crystal structure. The parameters that have effect on the field distribution have been determined. The obtained knowledge was used to propose a method of optimisation of photonic crystal's structure. The usefulness of the method has been experimentally confirmed. The increase of effectiveness of an optoelectronic device has been achieved.

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PhD student signature