Design, fabrication and characterisation of silicon based composite photonic materials

Tatiana Perova

Department of Electronic and Electrical Engineering, University of Dublin, Trinity College, Dublin 2, Ireland, e-mail: perovat@tcd.ie

This presentation is mainly focused on the design, fabrication and characterization of the photonic structures based on grooved and porous silicon serving as one-dimensional (1D) and two-dimensional (2D) photonic crystals, respectively. Both the transfer matrix method and band diagram method were applied for the calculation of photonic band gaps (PBGs) for 1D Si photonic crystals (PCs). The results of these calculations have been verified by optical microscopy measurements (FTIR and OSA). The optical properties of the wide range of composite materials fabricated by the infiltration of different compounds (liquid crystals, polymers, magnetic particles and luminescent materials) into porous and grooved silicon matrices will be also discussed. In particular, the significant enhancement (up to 20 times) of the Raman scattering on the molecular vibrations of different organic substances impregnated into grooved silicon structures have been revealed in this study. This effect can be used for the highly sensitive analysis of the Raman scattering of different compounds impregnated into the grooved silicon matrix. It was also shown that the optical properties of the composite structure (1D PC + liquid crystal) can be tuned by means of electro- and thermo-optical effects. The possibility of PBG extension by introducing a silicon wall thickness disorder into the photonic structure have been shown theoretically and experimentally. Such a structures suit well for the various elements of the integrated optics, micro-photonics and can serve as a building blocks for optical interconnects.