Recent progresses in 2D Photonic Crystal Slabs

– Ultrahigh-*Q* Cavities, Nano-devices, and Spontaneous Emission Control –

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In this presentation, recent progresses in 2D photonic crystal (PC) slabs will be reviewed based on our works. First of all, progresses in high-*Q* nanocavities in 2D PC slab is explained, where it is shown that the concept of Gaussian confinement [1] and ideas of tuning of air-holes [2] and/or double heterojunctions [3] enable to achieve nanocavities with ultrahigh-*Q* factor of 10^5~10^6 and small modal volume of ~$1(\lambda_0/n)^3$. Next, some examples of progresses in photonic nano devices are explained. The ultrahigh-*Q* nanocavities and the concept of in-plane hetero structure [4] enable to achieve photonic devices including highly efficient in-plane type channel add/drop filters [5,6] and optical memories [7]. Then, the capability of 2D PC slabs on the control of spontaneous emission is explained. In contrast to 3D photonic crystals [8], 2D photonic crystal slabs have a very interesting feature on the control of spontaneous emission. It is experimentally demonstrated that overall spontaneous emission rate is suppressed by 2D PBG effect, while emission efficiency for the vertical direction is significantly increased [9].

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