Electrical injection of a photonic crystal nanocavity

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A fundamental step towards achieving an "on demand" single photon source would be the possibility of electrical pumping for a single QD and thus the integration of such a device in an opto-electronic circuit. In this seminar will be described the fabrication process and preliminary results of a Light Emitting Diode (LED) integrated with a PhC nanocavity at telecom wavelength. We demonstrate the possibility of an effective electric pumping of the QDs embedded into the membrane by contacting the doped layers (p and n) of the thin membrane, and the excitation of cavity modes in a PhC nanocavity fabricated on it. A preliminary demonstration of the Purcell effect at 1.3 μm has been obtained measuring a 1.5 Purcell factor. In this way, we have demonstrated the enhancement of spontaneous emission dynamics in a photonic-crystal quantum dot LED. The relevance of this result is twofold: on one hand, it opens the way to the fabrication of LEDs and diode lasers with a modulation speed and turn-on delay not limited by the free-space spontaneous emission time. On the other hand the integration of electrical contacts with a coupled QD-cavity system allows the ultrafast electrical control of the coupling on a time scale shorter than the exciton coherence time due to Stoke shift. This will allow the coherent manipulation of excitonic and photonic qubits, a major step forward in the field of solid-state CQED, with potential application in quantum computing

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