# Imaging and manipulating confined electromagnetic fields in photonic crystal nanocavities with SNOM probes

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While a field effect transistor allows to modulate or switch on and off the flow of electrons, it has been a long-standing goal to make a nanodevice able to control the flow of photons on a chip. To challenge this objective, one needs both to localize photons at a subwavelength scale and to locally tune the material properties, by thermo or electro-optics effects[1-3] for instance. We demonstrated recently that switching and tuning can be achieved without modification of the material properties by approaching a sharp nanometric tip in the evanescent near-field of a nanocavity (Fig. 1). Such a possibility has been recently investigated theoretically [4] and experimentally[5,6]. However, until now switching has been achieved at the expense of a drastic decrease of the microcavity quality factor (Q), and thus the resonance tuning has not been effectively reported. In contrast to these previous works, we exploited a weak tip-cavity interaction regime, and evidenced switching and resonance tuning for a high-Q small-volume ($\approx 0.6\ (\lambda/n)^3$) silicon-on-insulator nanocavity. A 14dB reversible switching operation of the cavity transmittance (Fig. 2)) together with a 0.8-nm-wide tuning of the resonance wavelength have been observed[7]. Even at this early stage of development, we strongly believe that the present device may find use in a broad range of applications. Since its tuning range is being compatible with WDM inter-channel wavelength spacing, it can be used for building electromechanical wavelength-division multiplexing routers, the time scale for switching being limited by the mechanical resonance that could excess the MHz range with miniaturization [8].

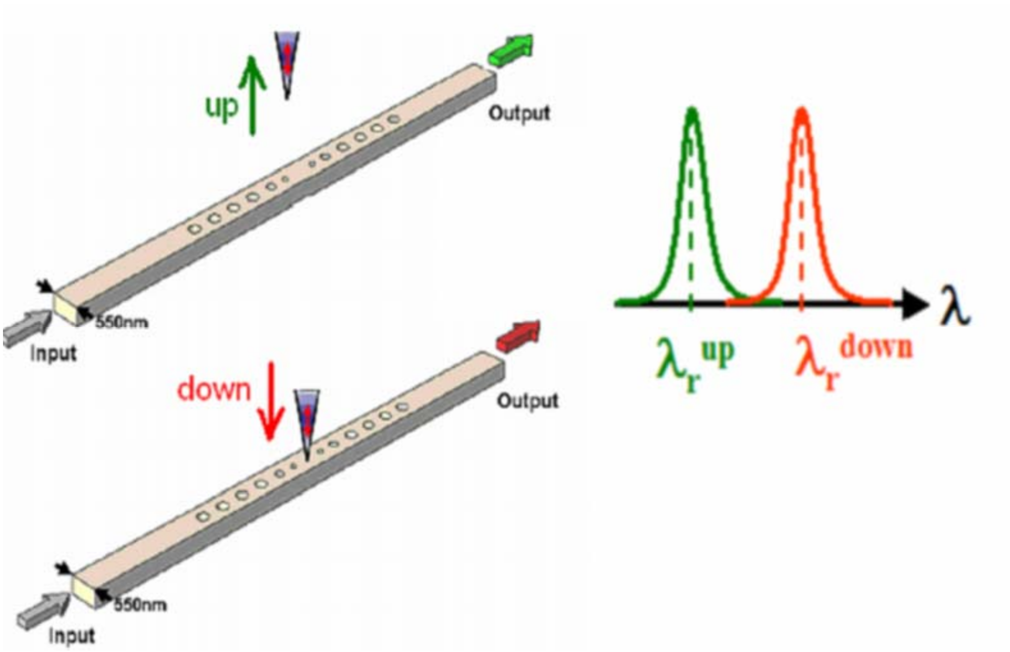


**Figure 1 Cavity tuning by a nanometric tip. Schematic view of the experiment. A nanometric tip is approached in the optical near-field of the cavity. This results in a red-shift of the cavity resonance wavelength.**

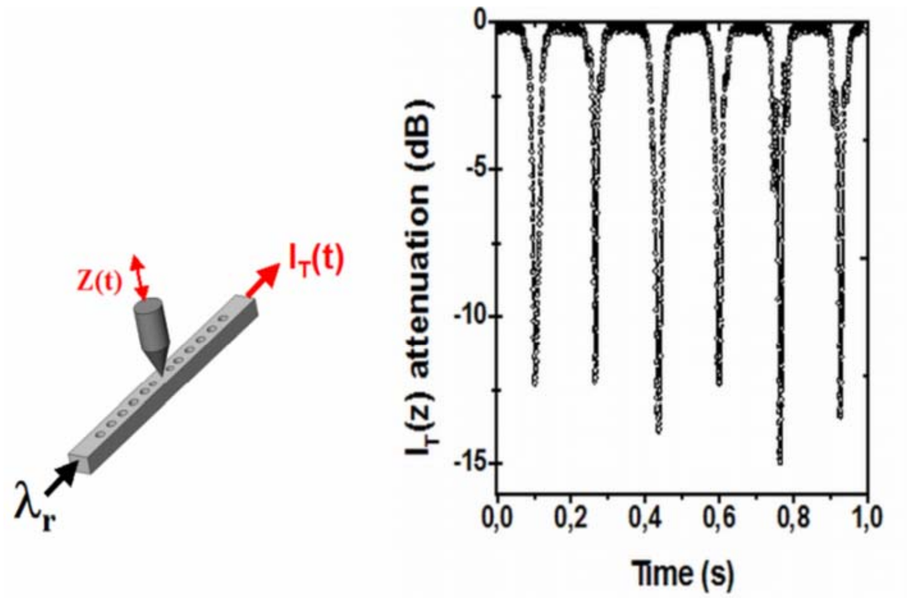


**Figure 2 Switching operation of the cavity-tip nanosystem: the cavity transmittance attenuation is modulated with the tip-cavity distance. For $\lambda=\lambda_r^{up}$ , at t= 0s, the tip is away, the transmittance is maximum when the tip is close to the surface (t=0.1s for example) the transmittance is strongly reduced.**

Acknowledgments

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