High Brightness Single Photon Sources Based on Photonic Wires

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We present a novel single-photon-source (SPS) based on the emission of a semiconductor quantum dot embedded in a single-mode photonic wire. This geometry ensures a very large coupling (>95%) of the spontaneous emission to the guided mode. Numerical simulations [1] show that a photon collection efficiency as large as 90% can be obtained for engineered nanowires with a tapered tip [2] and a metallic bottom mirror coated by a thin dielectric layer [3]. Experimentally, a record-high efficiency of 75 ±7% (for a NA=0.75 collection optics) has been measured for an InAs quantum dot embedded in such a nanowire, made of GaAs and defined by reactive-ion etching [4].

In the context of SPS, this novel approach, which provides spontaneous emission control over a wide spectral band, offers several important assets compared to cavity-based ones: 1) it can easily be applied to non-monochromatic emitters such as *F*-centers in diamond (or QDs at high temperature); 2) it is well suited to the development of wavelength tuneable SPS; 3) it is finally also very attractive for developing electrically pumped SPS; we will present original designs which should permit reaching SPS efficiencies well above 80%, whereas the best reported value to date is around 15%.

[1] I. Friedler et al.: "Solid-state single photon sources: the nanowire geometry", *Opt. Exp.* **17**, 2095 (2009).
[2] N. Gregersen et al.: "Controlling the emission profile of a nanowire with a conical taper", *Opt. Lett.* **33**, 1693-1695 (2008).
[3] I. Friedler et al.: "Efficient photonic mirrors for semiconductor nanowires", *Opt. Lett.* **33**, 2635 (2008).
[4] J. Claudon et al., *available on ArXiv*.