# Nanowire in Photonic Crystal Visible Light Source


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While semiconductor nanowires have emerged as ultra-small, low-cost and efficient light-sources, their integration with high quality resonators is expected to turn them into flexible coherent sources. This step is however very challenging [1,2]. Surface plasmon resonator are easier to integrate, yet their efficiency is dramatically reduced by strong non-radiative decay. Very recently, single nanowires have been placed within a photonic crystal resonator using an Atomic Force Microscopy instrument [3]. Despite the breakthrough in the field of nano-sized light sources, this procedure remains problematic in the perspective of large scale integration as wires are manually positioned one by one.

Here we demonstrate the integration of nanowires in photonic crystal membranes using a procedure which would be compatible with a semiconductor planar fabrication technology, similar to CMOS standards. The structure consists of a first layer of Silicon Nitride (SiN), on top of which Cadmium Selenide (CdSe) wires are deposited and buried beneath a second layer of SiN. The photonic crystal is then patterned around the wire. Fig. 1 a) shows the calculated electric field distribution at resonance of the cavity mode, induced by the contrast of the refractive indexes of the wire ($n_{CdSe}$=2.85) and SiN ($n_{SiN}$=1.9). In a single run 130 structures were fabricated, at least 16 exhibiting resonances with a mean wire positioning error of about 50nm, and an angular error below one degree (Fig. 1 b).

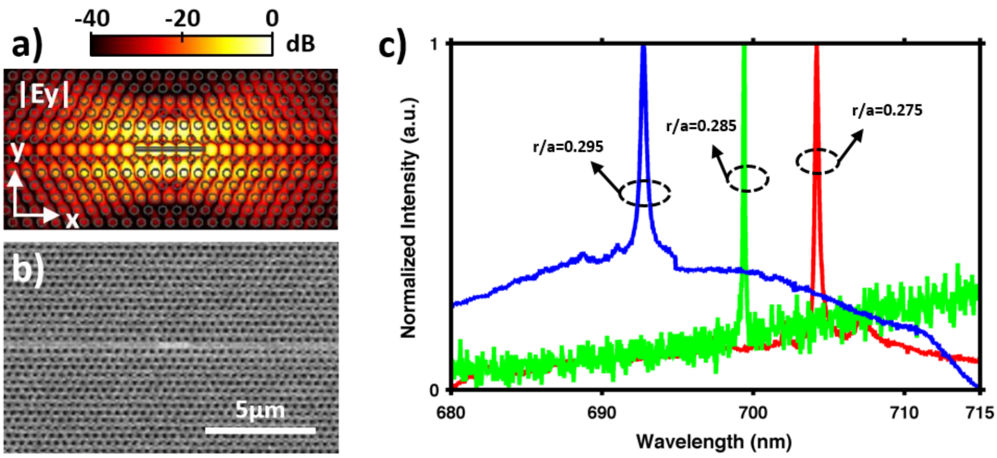


**Fig. 1** a) Electric field distribution at resonance (logarithmic scale); b) SEM image of a fabricated structure with a CdSe wire (light grey feature at the centre); c) Emission spectra pertaining to different cavities with slightly different design.

Fig. 1 c) shows the emission spectra of the devices, located in the [~680 - 725] nm range. Room temperature micro-photoluminescence measurements under CW laser pumping have been performed. Sharp resonances with Q factors ranging from 1000 to 10000 are reported. The resonance frequency is controlled by the design of the photonic crystal [4].

We note that owing to the broad transparency window of SiN, and to the flexibility of our fabrication method, the emission spectra of our source can be adjusted to a very broad extend by choosing suitable nanowires. Emission wavelength fine tuning is easily achieved through the design of the photonic crystal.

## References


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