Docket #: S12-312

Biological cell nanocavity probes

Stanford researchers have discovered an optical tool consisting of a semiconductor photonic crystal cavity affixed to the tip of an optical fiber. The photonic crystal cavity is shaped like a needle and is thin enough to puncture individual biological cells without causing damage to the cell. The optical properties of the cavities remain intact even when placed inside the cells and can be used for numerous things, e.g. the readout of the refractive index environment of the cell. Furthermore, these small cavities can be completely loaded in the cell by breaking them off the fiber tip.

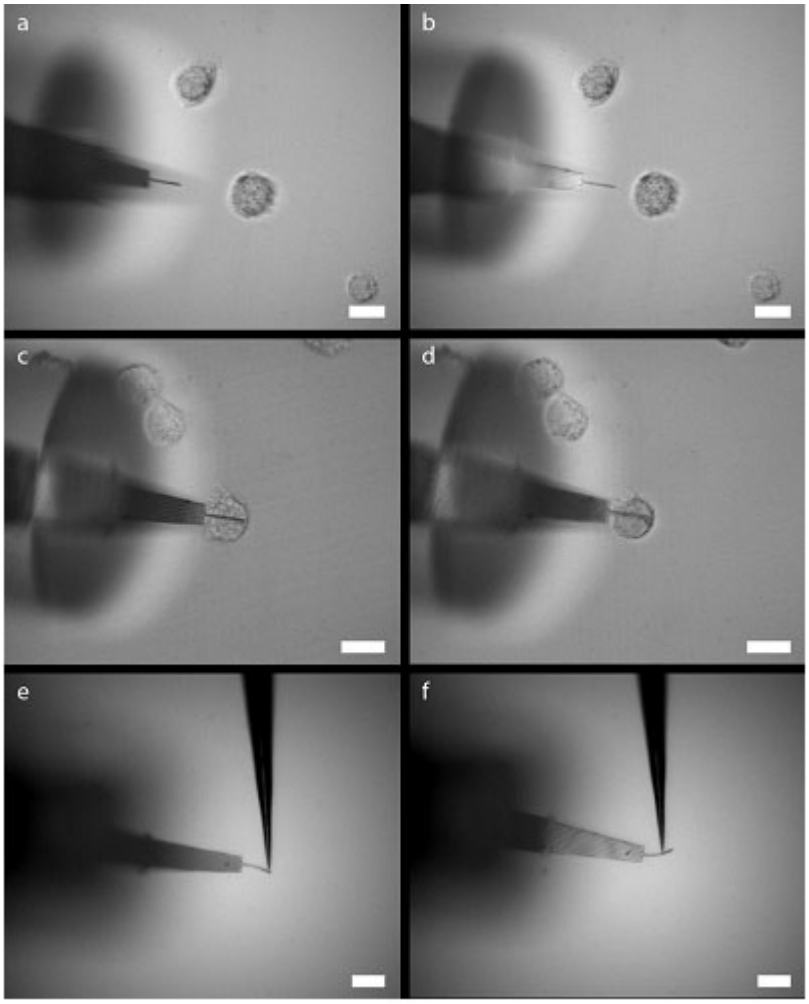

Figure 1 - Details of cell probing and beam flexibility. a, Image of a naoprobe

hovering above the dish surface. b, Image of a namoprobe with the membrane flush against the petri dish. c, Image of a probe in a cell with the focus placed on the top surface of the membrane, which is known to be on the substrate. d, Here the focus is placed on the top surface of the cell, which is several microns above the substrate surface. e,f, Flexibility testing of the nanobeam by deflecting it with a 200 nm wide tip Tungsten electrical probe. Scale bars, 20 &microm.

Applications

- Label free single-cell biomarker (protein) sensor
- Label free single-cell DNA/RNA sensor
- Label free single-cell biomolecule sensor
- Semiconductor lasers inside single cells
- Optical traps inside single cells
- Photoacoustic sensors inside single cells

Advantages

- **First successful demonstration:** first example of functional photonic crystal cavities, or nanocavities of any kind inserted in single biological cells.
- **Device optical properties:** Device optical properties inside such biological material remains of high quality and therefore the numerous applications of photonic cavities can be translated into single-cell studies.
- **Non-cytotoxicity:** Devices are shown to induce minimal harm to biological cells and can therefore be used for in vitro or in vivo studies on any number of biological or medical applications.

Publications

- Gary Shambat, Sri-Rajasekhar Kothapalli, J Provine, Tomas Sarmiento, James Harris, Sanjiv Sam Gambhir, and Jelena Vu?kovi?, "Single-Cell Photonic Nanocavity Probes", *Nano Letters*, February 6, 2013.
- "Stanford scientists fit light-emitting bioprobe in a single cell", *Stanford Report*, February 19, 2013.

Patents

- Published Application: 20140170695
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