A. Absorption efficiency of a freestanding silicon microcavity.

Here we show a very simple calculation based on an isolated freestanding silicon cavity. Using different calculation methods, we will discuss on the influence of the substrate on the Mie modes, the effect of an inner porosity and, finally, demonstrate how a very small deformation of the spherical shape also influences the optical properties of the device. Absorption efficiency calculations were performed using the classical Mie solutions for the scattering of a free standing sphere embedded in air\(^2\). By neglecting the substrate and tip effects we are assuming that, at high incidence angles, light can resonate at a plane which does not interact strongly with both the substrate and the tip. We considered the real part of the refractive index of silicon tabulated in Palik's handbook\(^2\). Regarding the absorption coefficient, we considered the data coming from \(\mu c\)-Si obtained by chemical vapour deposition\(^2\). These values are also used for studying the influence of the substrate, the sphere porosity, and the sphere deformation, as we are reporting below. Calculations were performed using directly the sphere diameter obtained from the AFM measurements. In the Supplementary Figure 2 we show both, the measured photoresponse of a 3.3 \(\mu m\) large device along with the calculated absorption efficiency of a silicon microcavity of the same size. To mimic the finite resolution of experiments, the calculation have been convoluted with a Gaussian bell whose full width at half maximum (FWHM) corresponds to the spectral resolution of the experimental system (0.5 nm). Although theory shows resonant features that remind those from experiments, it cannot explain both the number of resonances as well as their wavelength...
positions. The disagreement between experiments and theory can be due to several factors, namely: A) The naïve model used; high order WGMs of the microcavity can be influenced by the substrate (see below). B) The CVD process can slightly warp the spherical shape, thus modifying the position and the degeneracy of the Mie resonances. C) The internal structure of silicon microcavities can be non-homogeneous as it can be seen from the SEM images of Supplementary Figure 1, this influencing the absorption spectrum of the device.

B. Influence of the substrate on the optical properties of the microcavity.

We have performed a FDTD simulation (FDTD Solutions, Lumerical Co.) to calculate the absorption efficiency of a silicon microcavity located on a silicon substrate. We have assumed a zero value for the imaginary part of the silicon substrate. Due to the limited resources of our computer we cannot afford computing the large wavelength range measured. We have restricted ourselves to a small wavelength region to show the influence of the substrate. The black line spectra of Supplementary Figure 3 shows the FDTD results of a silicon microcavity, 3.3 micrometres large, supported on a silicon substrate at different incidence angles, (with respect to the substrate plane). The red dashed line corresponds to the absorption efficiency of a free-standing sphere. By comparing both spectra we can see the strong influence of the substrate. The presence of the substrate destroys the narrow resonances at normal incidence angle (90°, see Supplementary Figure 3a). At the incidence angles, like those from the experiments, the effect of substrate decreases and sharp absorption peaks appear again (see Supplementary Figures 3d and 3e). Nevertheless, the
substrate still has a strong influence in the position and shape of the resonances while new features seem to appear.

**C. Influence of the sphere deformation on the optical properties of the microcavity.**

The optical absorption efficiency was calculated for different oblate spheroids that can be characterized by two parameters: $a$ and $b$, being $a$ the symmetry axis. The simulations are based on the T-matrix method\textsuperscript{26}. We used the subroutines developed by P.W. Barber and S.C. Hill.\textsuperscript{27} We considered $a/b$ ratio values very close to the unity. Figure S4 shows the calculated absorption efficiency (blue curves) for $a/b$ equal to 1 (spherical case, bottom spectrum), 0.995, and 0.97 (blue top spectrum). The parameters, $a$ and $b$, of the spheroid were found by using the condition that the volume of the spheroid equals to the volume of a 3.3 micrometers diameter sphere. Tiny deformations of the spherical shape results on strong modifications of the absorption efficiency spectra. For comparison purposes the Supplementary Figure 4 also shows (black curve) the experimental photocurrent for a 3.3 micrometers diameter sphere, shown in the Figure 4.

**D. Influence of the internal porosity on the optical properties of the microcavity.**

As a first approach to the effect of the internal porosity, we have modelled the system as a two layer particle: an outer layer of solid silicon and an inner nucleus of porous silicon with optical properties defined by the effective media theory. This structure can be characterized by three parameters: the external particle size $d$, the nucleus size $d_i$, and the nucleus porosity $p_i$. We have also used the Mie
subroutines developed by P.W. Barber and S.C. Hill. The Supplementary Figure 5 shows the case of a 3.3 micrometers large particle for different nucleus size values (right panel) and different nucleus porosity values (left panel). All calculations were convoluted by a Gaussian bell to account for the finite resolution (0.5 nm) of the experimental set-up. As the calculations show, a porous nucleus affects both low-Q and high-Q resonances.
Supplementary Figure 1. Section of two microcavities carved with a focused ion beam.

The left and right sphere diameters are 3.7 µm and 3.5 µm, respectively. The contact between sphere and substrate is typically 1 µm wide. Also, a few defects (air voids) can be seen inside the spheres, the left and the right spheres being examples of devices with lower and higher density of voids. Notice that a slight deformation in introduced in the lower half of the sphere due to material redeposition during the FIB milling.
Supplementary Figure 2. Absorption efficiency of a freestanding silicon microcavity. The black curve corresponds to the experimental photocurrent spectrum of a sphere with a diameter of 3.3 µm. The blue line is the absorption efficiency calculation considering a freestanding silicon sphere of the same diameter.
Supplementary Figure 3. FDTD calculation of a sphere of 3.3 µm in diameter deposited on a silicon substrate. The red dash lines correspond to the absorption efficiency of an isolated silicon sphere in air. The black lines from (a) to (e) correspond to the absorption efficiency of the same size silicon sphere at different incidence angles.
Supplementary Figure 4. Influence of the sphere deformation on the optical absorption.

Blue curves correspond to the calculated absorption for different oblate spheroids (see inset), characterized by parameters $a$, and $b$, being $a$ the symmetry axis. The impinging light wavevector is tilted 58 degrees with respect the symmetry axis $a$. From bottom to top, $a/b$ is: 1 (spherical case), 0.995, and 0.97. All the spheroids have a volume equal to that of a 3.3 micrometers in diameter sphere. The black curve corresponds to the experimental photocurrent spectra of the 3.3 micrometers large spherical diode, shown in Fig. 4.
Supplementary Figure 5. Influence of porosity on the absorption efficiency spectrum.

The figure shows absorption efficiency calculations for a 3.3 µm diameter, $d$, sphere including a porous core. Left panel shows different absorption spectra for a nucleus silicon core of diameter $d_i=0.5d$ and a nucleus porosity (starting from the bottom curve) of 0%, 20%, 40%, 60% and 80%. Right panel shows different absorption spectra for a nucleus porosity of 50% and a nucleus size (starting from the bottom), $d_i=0$(non porous case), 0.2$d$, 0.4$d$, 0.6$d$ and 0.8$d$. 
Supplementary Figure 6. Measured current-voltage characteristics of a typical device. (a) I(V) characteristic curves in linear scale. The × symbols correspond to the dark illumination curve, while the + symbols correspond to monochromatic illumination conditions with $\lambda = 990$ nm. (b) Detail of the (a) curve for fill-factor evaluation purposes (notice that the current direction convention has been changed). The blue line represent the output power calculated by using the interpolated data.