# 나노패턴 & 나노소재 이용 태양전지

# Three-dimensional nanopillar-array photovoltaics on low-cost and flexible substrates

University of California at Berkeley

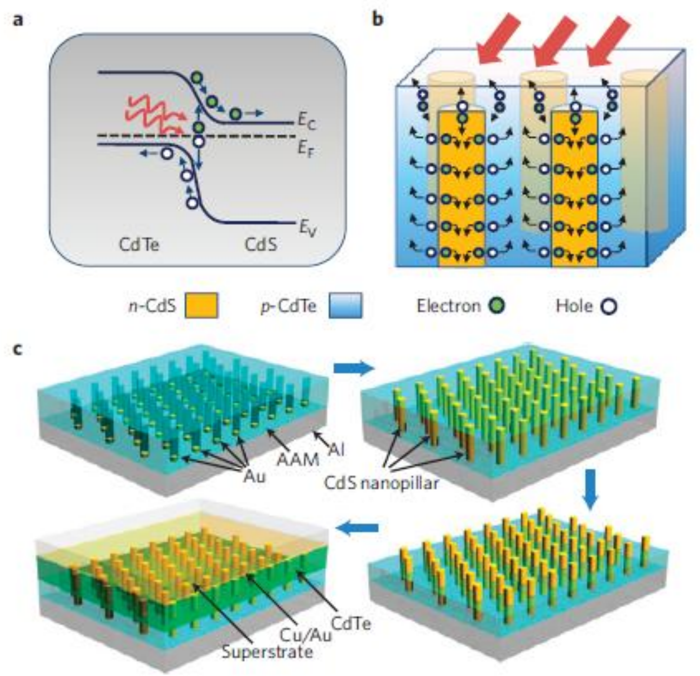


**Figure 1 | CdS/CdTe SNOP cells. a**, Energy band diagram of a CdTe/CdS photovoltaic. **b**, Cross-sectional schematic diagram of a SNOP cell, illustrating the enhanced carrier collection efficiency. **c**, SNOP-cell fabrication process flow.

나노 기둥 구조 이용 태양전지 개발

200nm 크기, 500nm 높이 CdS 기둥 이용
AAO 기술로 제작

6% 효율

nature materials

LETTERS

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다공성 Aluminum membrane

CdS nanopillar

TEM image

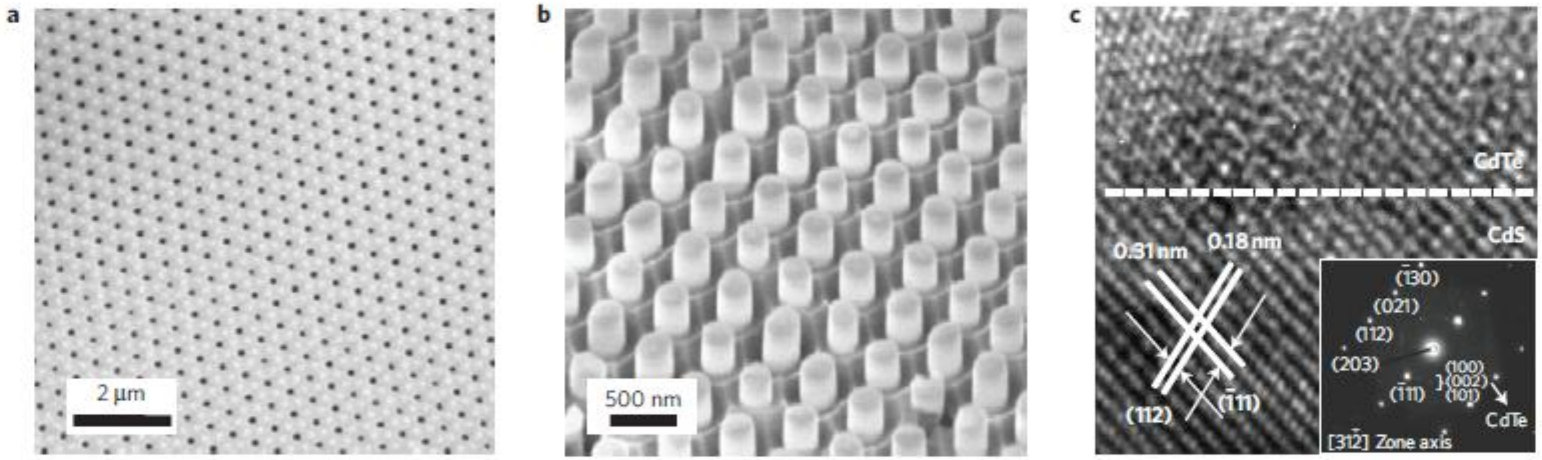



**Figure 2 | SNOP cell at different stages of fabrication. a**,**b**, SEM images of an as-made AAM with perfectly ordered pores (**a**) and a CdS nanopillar array after partial etching of the AAM (**b**). **c**, Transmission electron micrograph of the interface between a single-crystalline CdS nanopillar and a polycrystalline CdTe thin film. Inset: The corresponding diffraction pattern for which the periodically symmetric spots and multi-rings can be found. The symmetric spots are originated from the single-crystalline CdS nanopillar and the multi-rings are originated from the polycrystalline CdTe thin film.

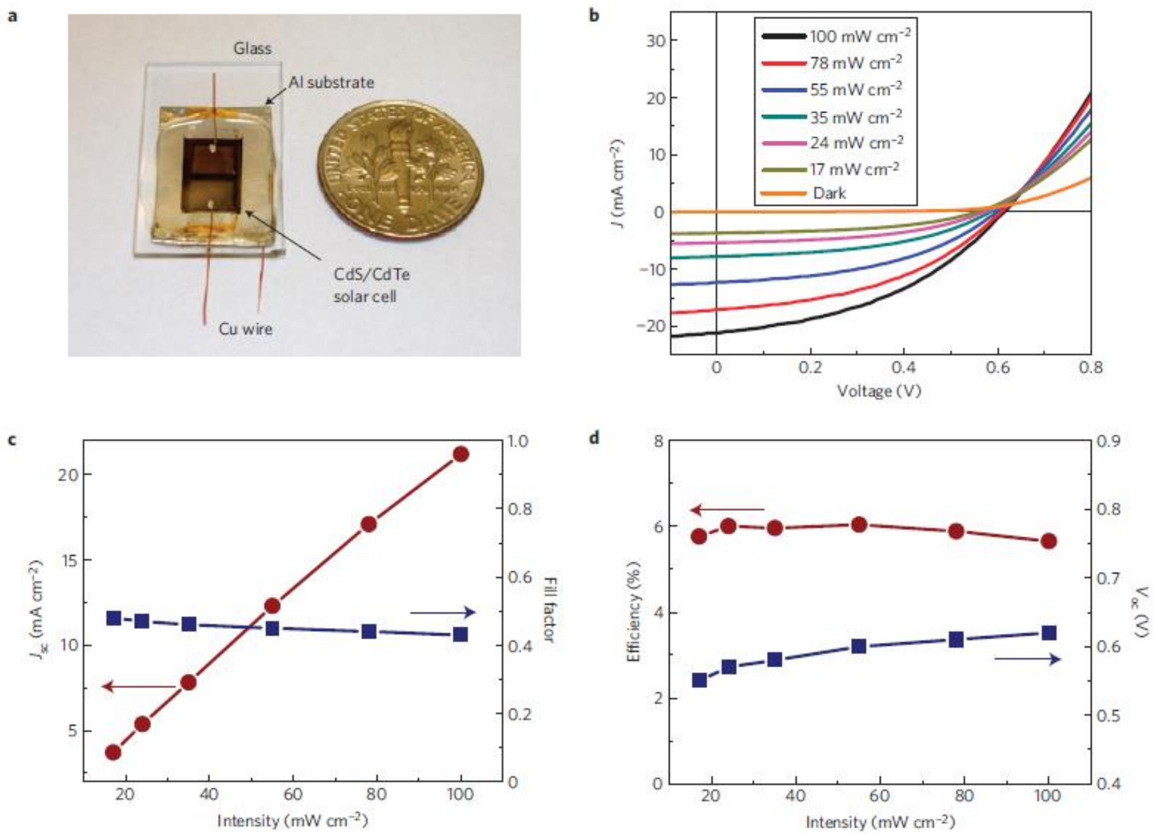



**Figure 3 | Performance characterization of a representative SNOP cell. a**, An optical image of a fully fabricated SNOP cell bonded on a glass substrate. **b**, *I*–*V* characteristics at different illumination intensities. **c**, The short-circuit current density, $J_{sc}$, shows a near-linear dependence on the illumination intensity, whereas the fill factor, *FF*, slightly decreases with an increase of the intensity. **d**, The open-circuit voltage, $V_{oc}$, slightly increases with the intensity and the solar energy conversion efficiency is nearly independent of the illumination intensity for $P = 17 \sim 100$ mW cm$^{-2}$.

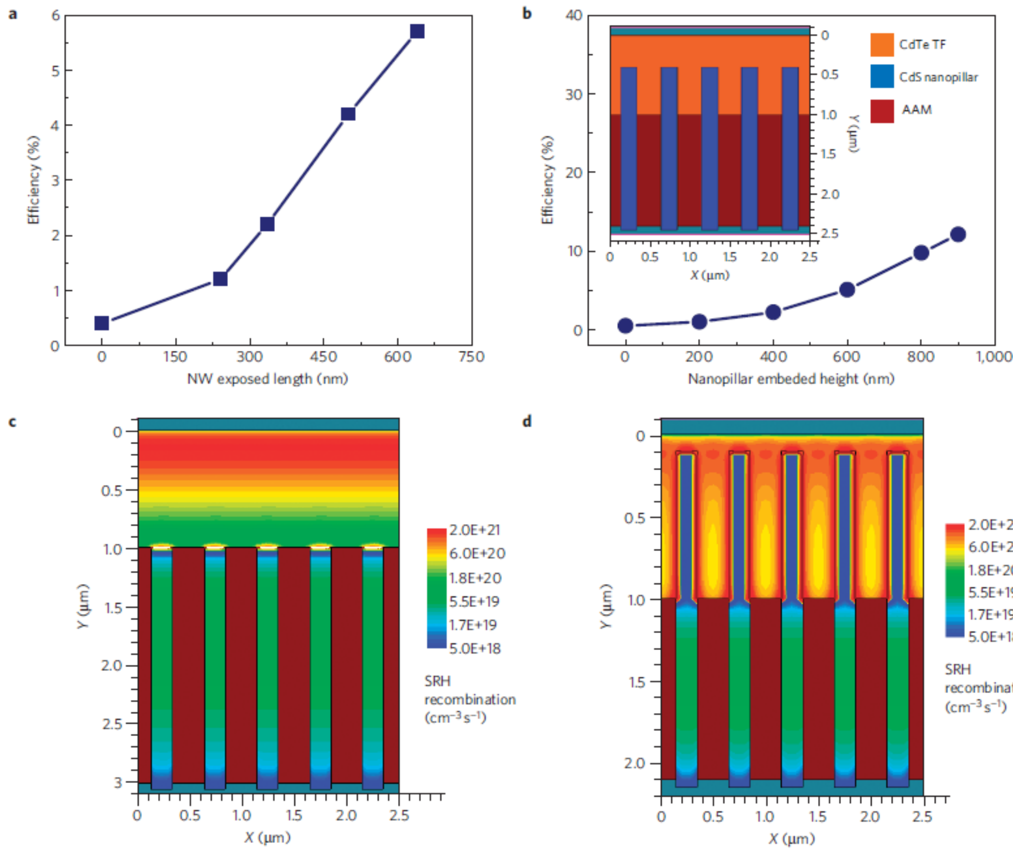
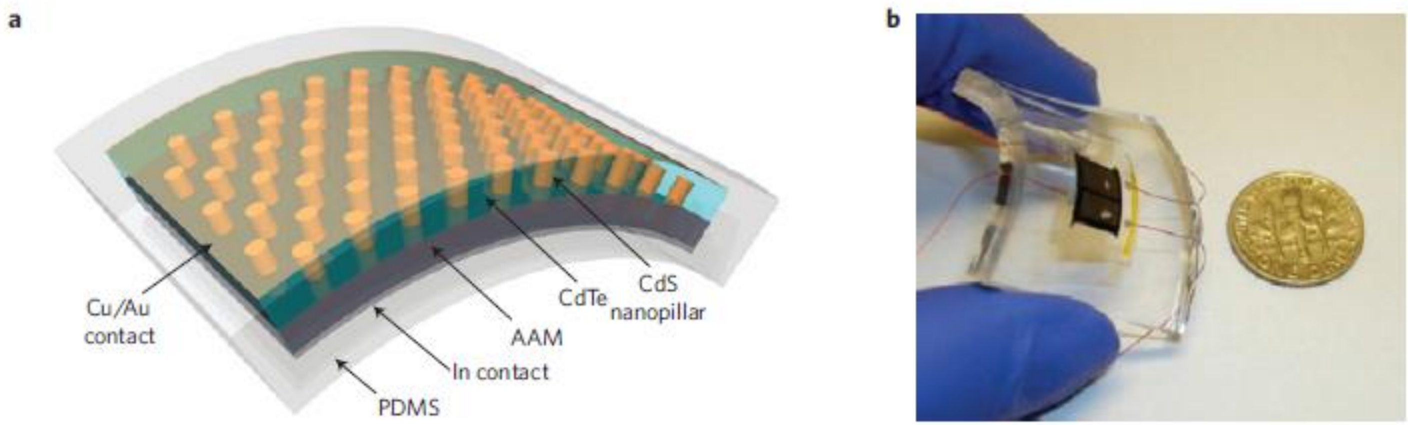


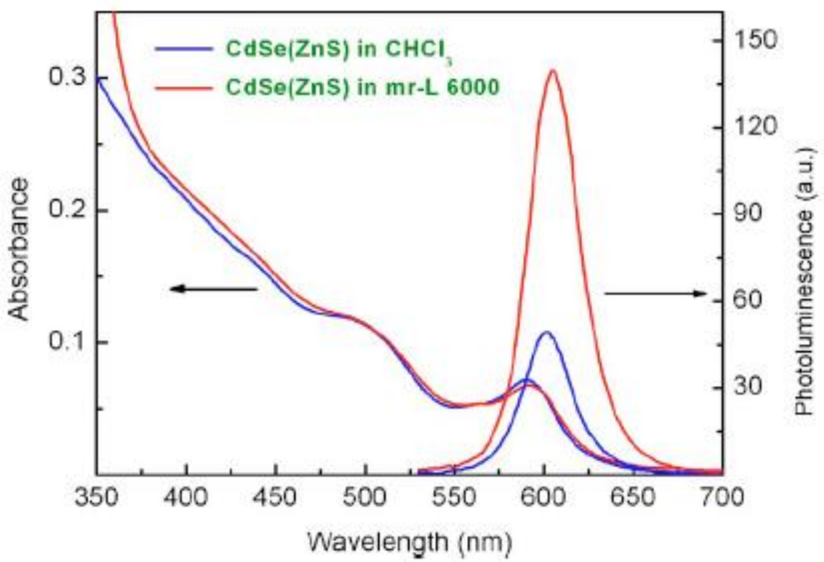

**Figure 4 | Effects of the nanopillar geometric configuration on the device performance. a**, Experimentally obtained efficiency of SNOP cells as a function of the embedded nanopillar height, *H*. NW: nanowire. The CdTe film thickness is maintained constant at ~1 μm. **b**, Theoretical simulation of the SNOP cell efficiency as a function of *H*, in qualitative agreement with the observed experimental trend shown in **a**. TF: thin film. Inset: Schematic diagram of the SNOP cell used for the simulation. **c**,**d**, Visualization of the Shockley–Read–Hall (SRH) recombination in SNOP cells with $H = 0$ (**c**) and 900 nm (**d**). The space charge and carrier collection region is quite small when $H = 0$ nm, resulting in a major carrier loss in the upper portion of the CdTe film through recombination, where there is a high EHP optical generation rate. However, the space charge and carrier collection region is significantly enlarged when $H = 900$ nm; thus, the total volumetric carrier recombination loss is greatly reduced.

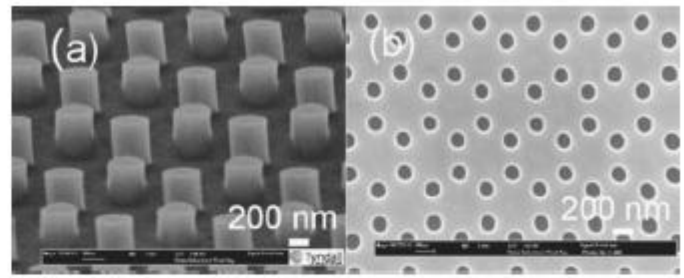


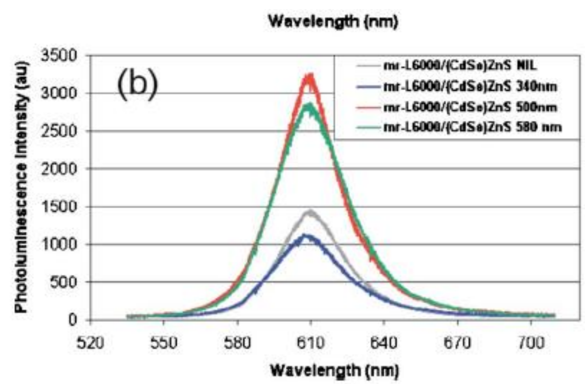

PDMS 이용 유연 태양전지

APPLIED PHYSICS LETTERS **90**, 011115 (2007)

# Spontaneous emission control of colloidal nanocrystals using nanoimprinted photonic crystals



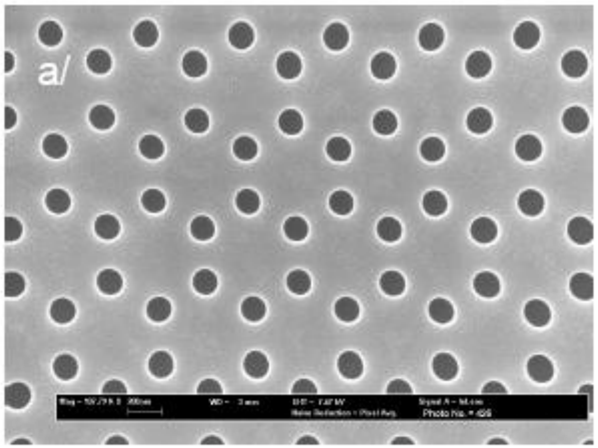



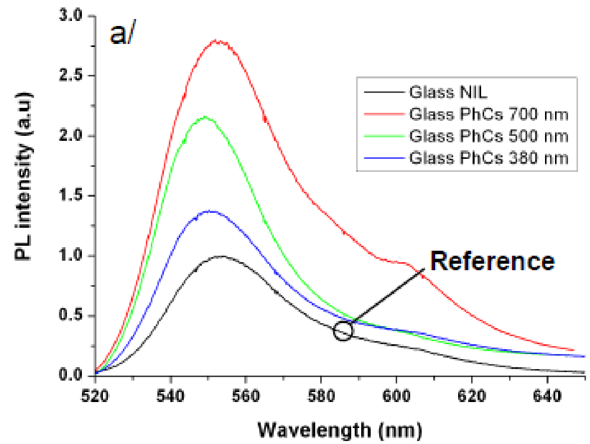



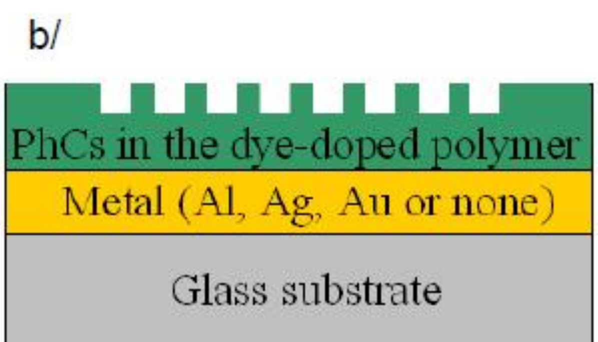

광결정 패턴+양자점 : 발광효율 향상

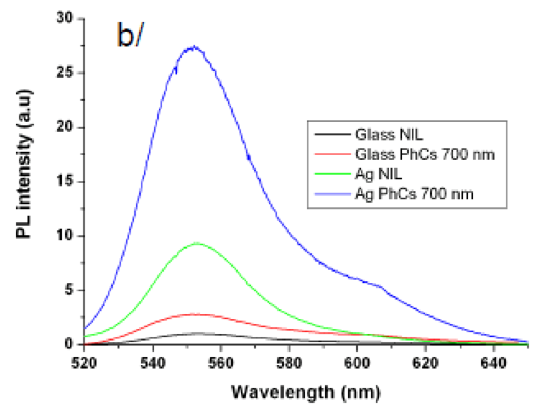
# Photoluminescence enhancement in nanoimprinted photonic crystals and coupled surface plasmons

V. Reboud[1*], N. Kehagias[1], M. Zelsmann[2], C. Schuster[3], M. Fink[3], F. Reuther[3], G. Gruetzner[3]and C. M. Sotomayor Torres[1]



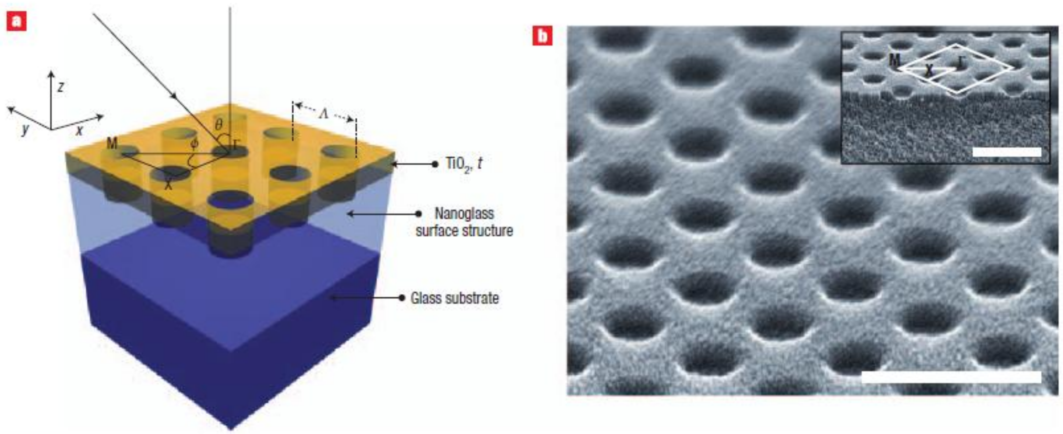



# Enhanced fluorescence emission from quantum dots on a photonic crystal surface

nature nanotechnology | VOL 2 | AUGUST 2007 | www.nature.com/naturenanotechnology



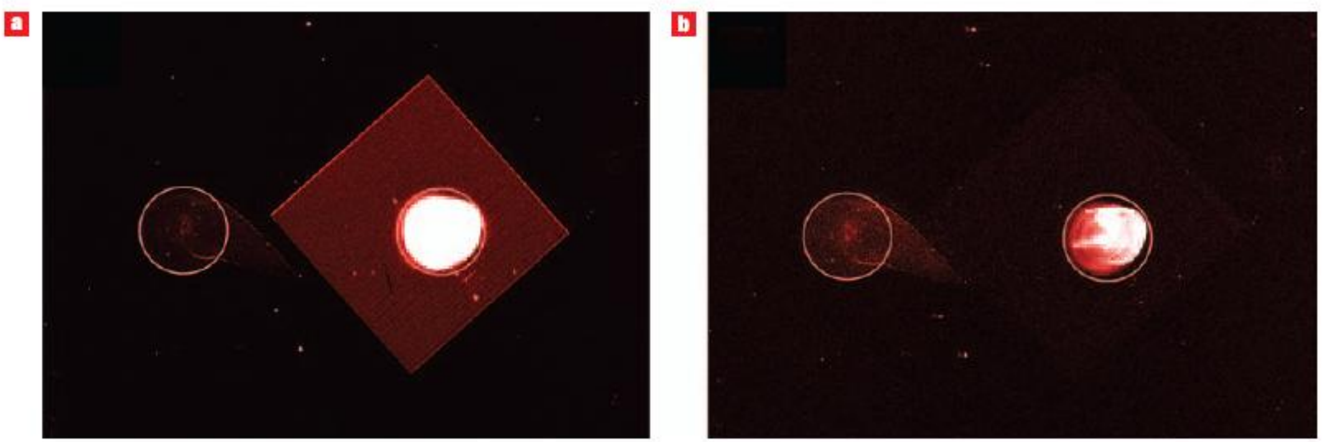
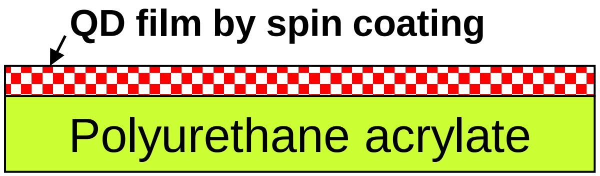
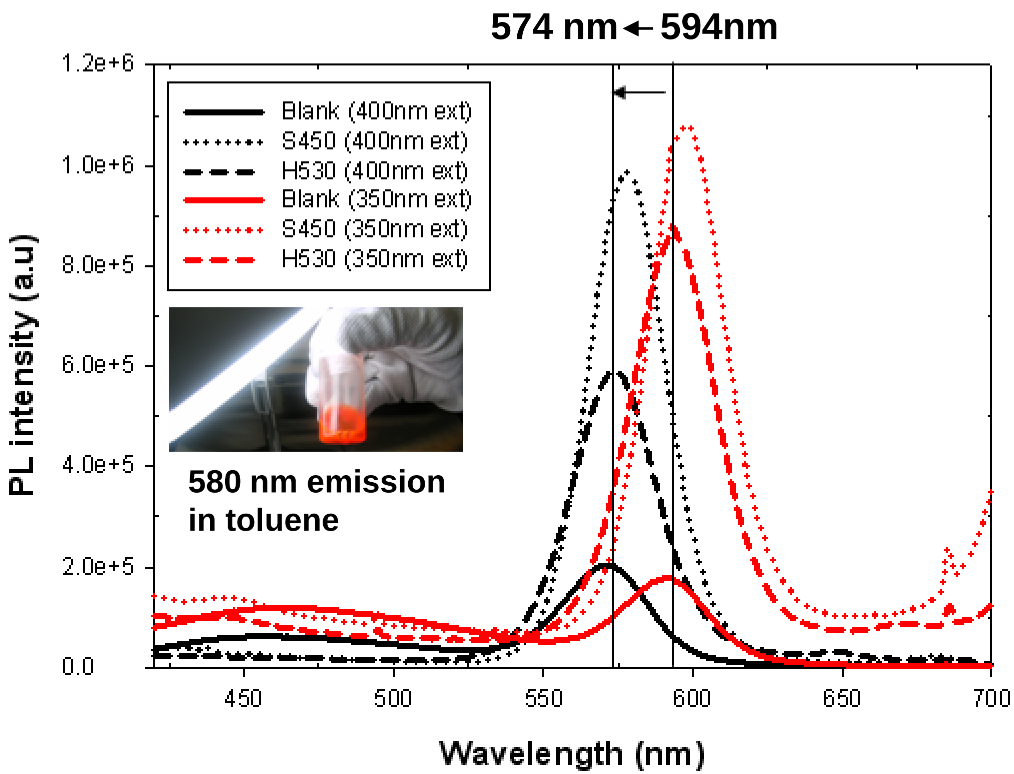



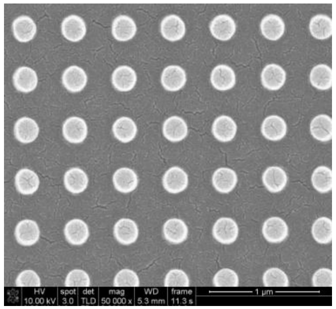

**Figure 5 Enhanced fluorescence emission from QDs on the PC surface.** Fluorescence (pseudocolour) scan images of the PC with QDs dispersed on the surface. **a**, Scan taken when the PC is resonant with respect to the incident beam ($\theta = 11.2°$), showing an enhancement factor of over 108 times. **b**, Scan taken when the PC is not resonant with the incident beam ($\theta = 0°$), showing an enhancement factor of over 13 times. The circular regions represent the area over which intensity information was averaged. In both images, the circle to the left shows the control region where no PC is present.

# QD emission
# by nanostructure

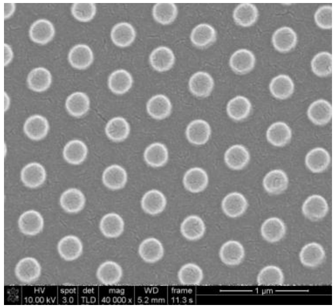


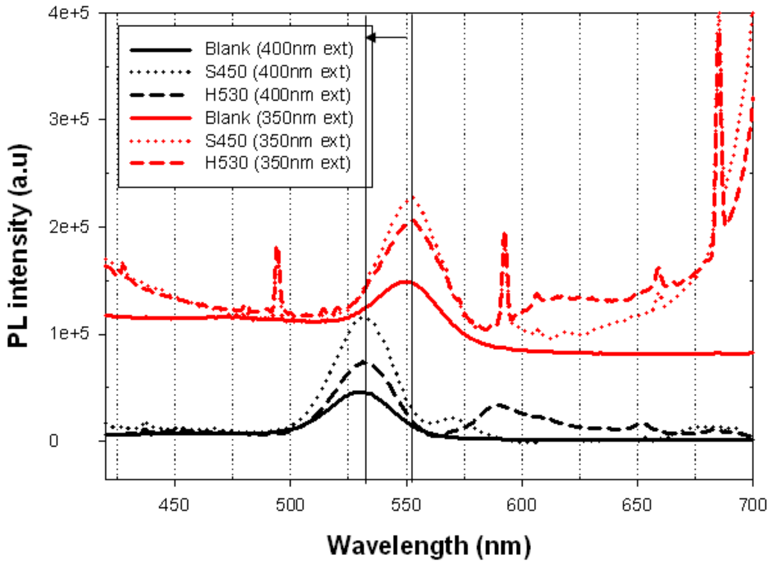

**S450 (Cub, a=450nm)**

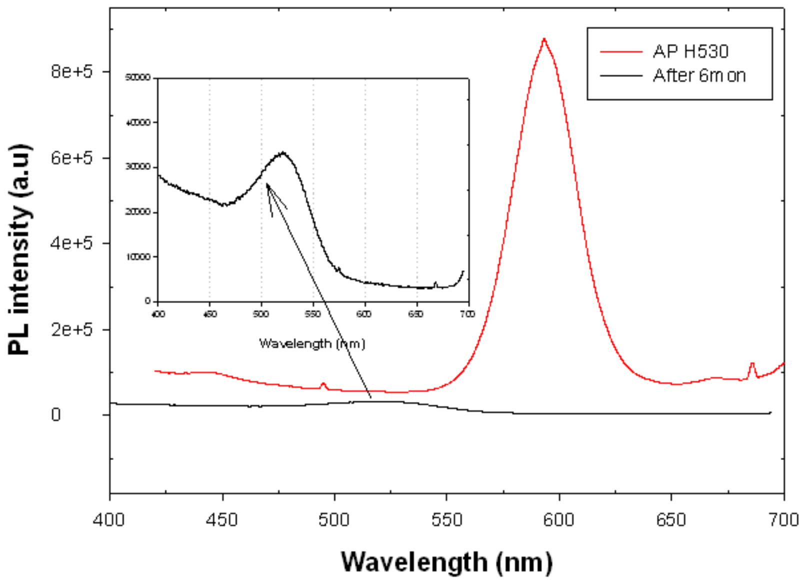


**H530 (Hex, a=530nm)**

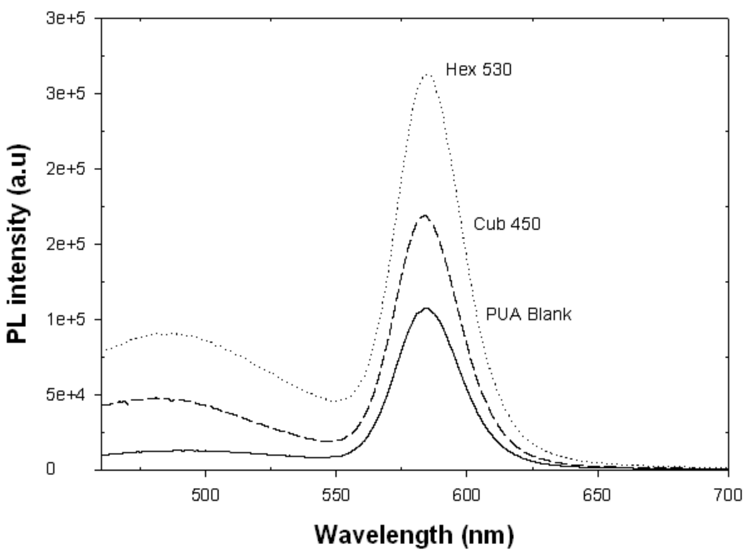


# QD emission by nanostructure

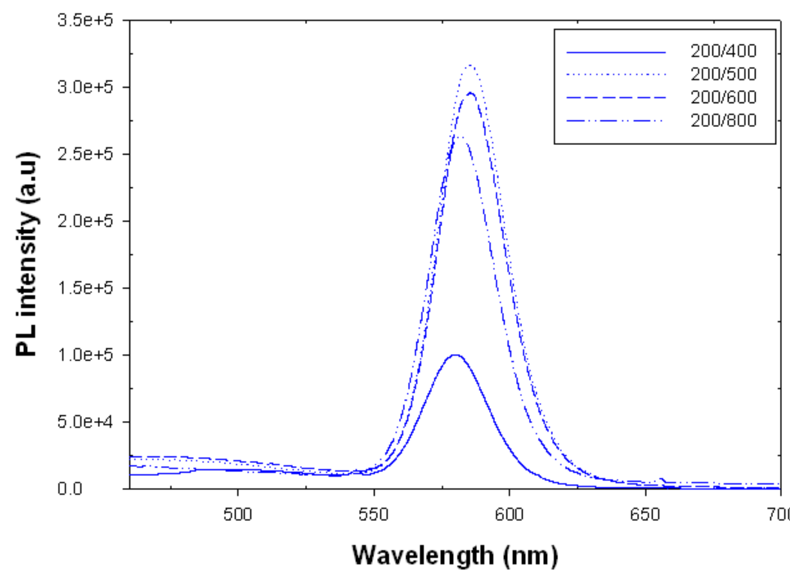



After 6 month



Hex 530
Cub 450
PUA Blank
PL intensity (a.u)
Wavelength (nm)

200/400
200/500
200/600
200/800
PL intensity (a.u)
Wavelength (nm)