Electronic Supplementary Material (ESI) for Nanoscale.

Supplementary information

Polarization-dependent enhanced photoluminescence and polarization-independent emission rate of quantum dots on gold elliptical nanodisc arrays

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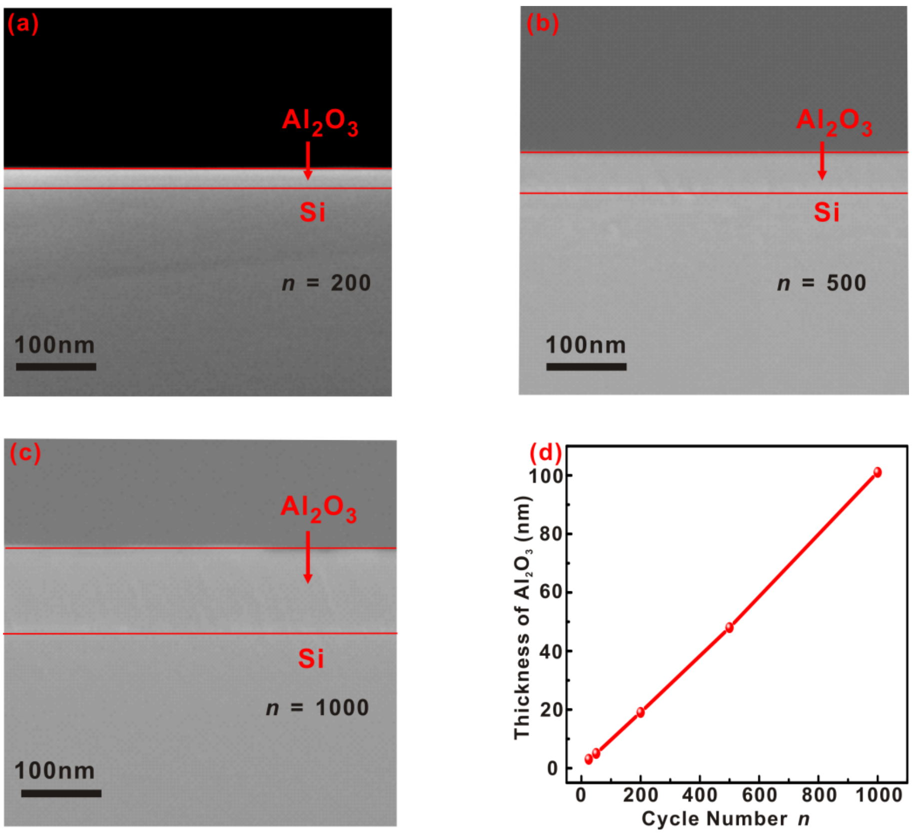

Figure S1 The thickness of the Al_2O_3 layer with different cycle number (n). (a-c) The cross-section of scanning electron microscopy images of the Al_2O_3 film deposited on the Si substrate. The cycle numbers, *n,* are 200, 500, and 1000, respectively. (d) The thickness of the Al_2O_3 film as a function of the cycle number. Liner fitting of the data points shows that the growth speed is 0.1 nm per cycle. In order to see the thickness of Al_2O_3 film clearly, we use the red lines to mark the interface between the silicon and Al_2O_3, and the interface between Al_2O_3 and air.

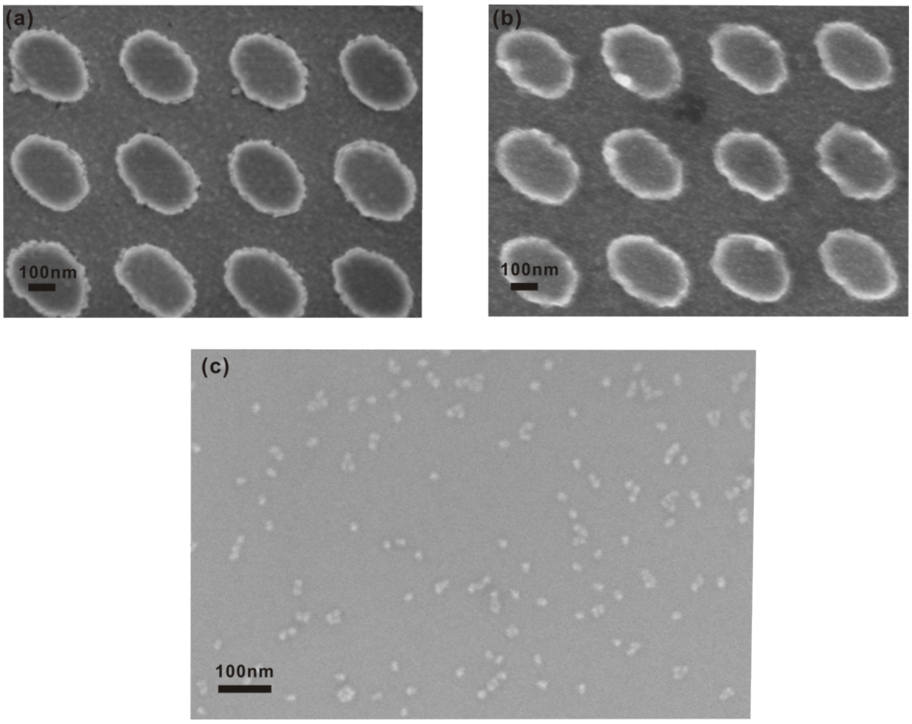

Figure S2 (a) SEM image of the Au ND array without QDs; (b) SEM image of the Au ND array covered with QDs, which is quite clear due to the discharge of the substrate; (c) SEM image of QDs dispersed on Si substrate. It can be seen that the QDs are homogeneously distributed onto the silicon substrate and Au ND arrays.

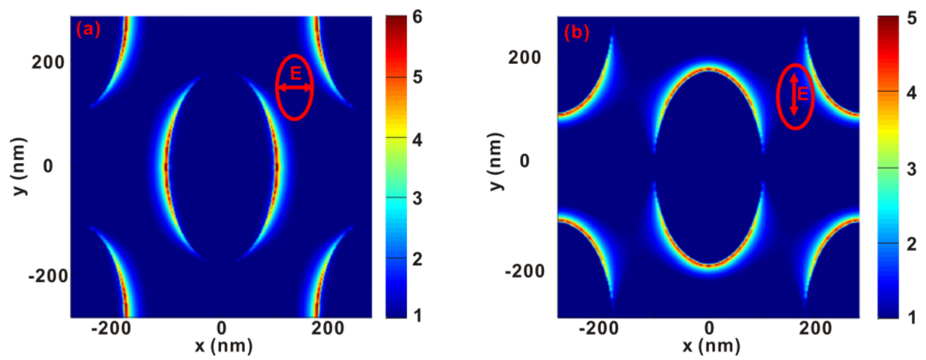

Figure S3 (a) The electric field amplitude distribution of Au elliptical nanodisc (ND) when it is illuminated by light with a wavelength of 659 nm and polarization parallel to the minor axis; (b) The electric field amplitude distribution of the Au elliptical ND when it is illuminated by light with a wavelength of 930 nm and polarization parallel to the major axis. The film thickness of the Al_2O_3 layer is 3 nm. The scale bar for the electric field amplitude distribution is at the linear scale. Large electric field enhancement mainly exists at the surface of the Au elliptical ND.

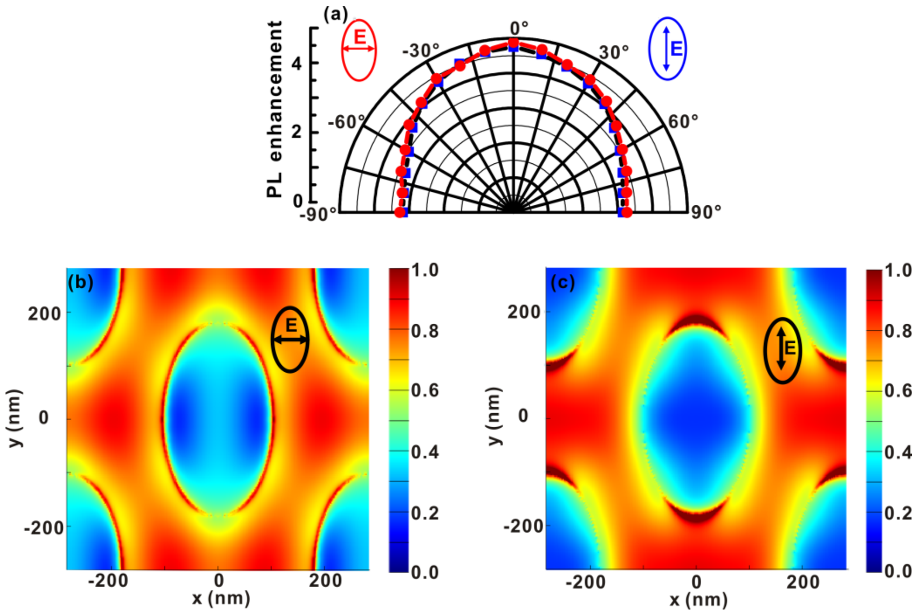

Figure S4 The emission properties of the QD-NDs hybrid system illuminated by the excitation light with different polarization. (a) The polar plot of the quantum dots (QDs) photoluminescence as a function of θ (polarization angle) at the wavelength of 659 nm, the red and blue curves represent the PL enhancement under the excitation laser with polarization parallel to the minor and major axes respectively. The angle θ between the polarization of the emission light and the minor axes is defined as 0°, when they are parallel. (b) and (c) show the electric field amplitude distribution of Au elliptical ND at the excitation wavelength (400 nm)**.** The polarization of excitation light is paralleled to the minor and major axes, respectively. The scale bar for the electric field amplitude distribution is at the linear scale. The film thickness of the Al_2O_3 layer is 3 nm. Because the excitation wavelength is far away from the localized surface plasmon resonance wavelength of the ND array, whatever the polarization of the pump laser changes, the polarization properties of the PL are the same. This means that the polarization of pump laser doesn't affect the study of polarization property of the PL.

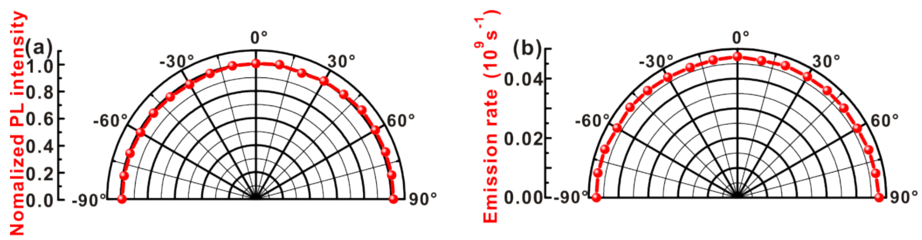

Figure S5 The emission properties of the QDs on quartz slide deposited with 10 nm of Al_2O_3 film. (a) and (b) show the polar plot of the quantum dots (QDs) photoluminescence and emission rate as a function of θ (polarization angle) at the wavelength of 659 nm without NDs. The emission intensity and emission rate are polarization-independent.