Electronic Supplementary Material (ESI) for Nanoscale.

Supporting information

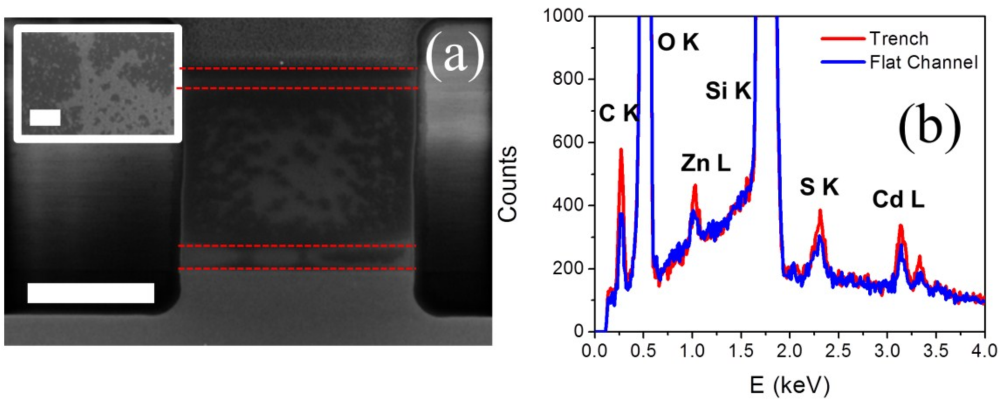

Fig. S1 (a) A typical SEM image showing the device channel region with drop cast NQDs. Red dotted lines indicate the position of the two trenches. On the flat channel region, non-continuous NQD films are clearly observed. The inset shows a magnified view of the close packed NQD film on the flat channel region. The scale bar is 300 nm. (b) EDAX spectra of the trench region (red) and the flat channel region (blue). The same sampling area ($1.5 \times 4.5\ \mu m^2$) is used for the two regions. Each spectrum was integrated for 5 minutes. The Cd L, S K and Zn L peaks come from CdSe/ZnS NQDs. The Se peak is very close to the Si K peak and thus is buried in the Si background. The C K peak is either resulted from organic capping ligands of NQDs or surface organic contaminations. In the trench region, the Cd, Zn and S peaks are clearly larger than those of the flat channel region.

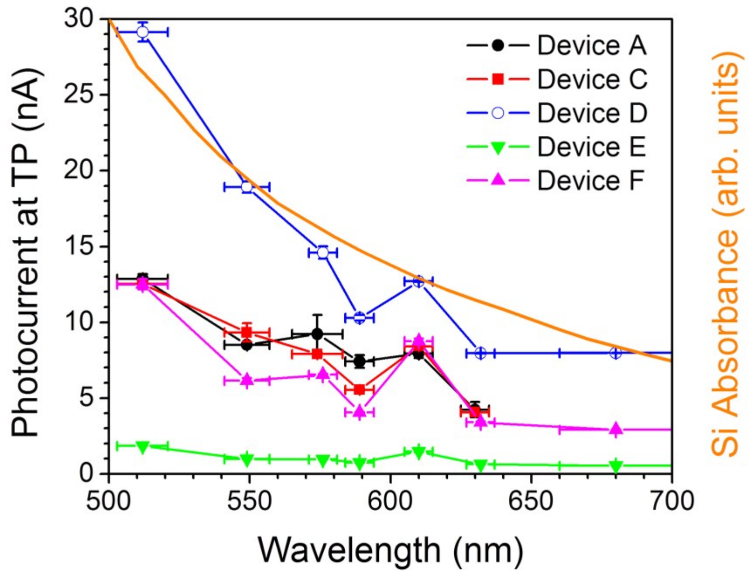

Fig. S2 Photocurrent at the transition point for SAM terminated devices as a function of the excitation wavelength. The excitation power is set to be 20 μW for different wavelength. The Si absorption curve is calculated according to the absorption coefficient of Si taken into consideration the effects from the photon density variation. The photocurrent closely follows the behavior of Si absorption. The current level has a large variation between different devices due to the existence of trenches near the doped/undoped junction. The current behavior of Device E is shown in the main text.

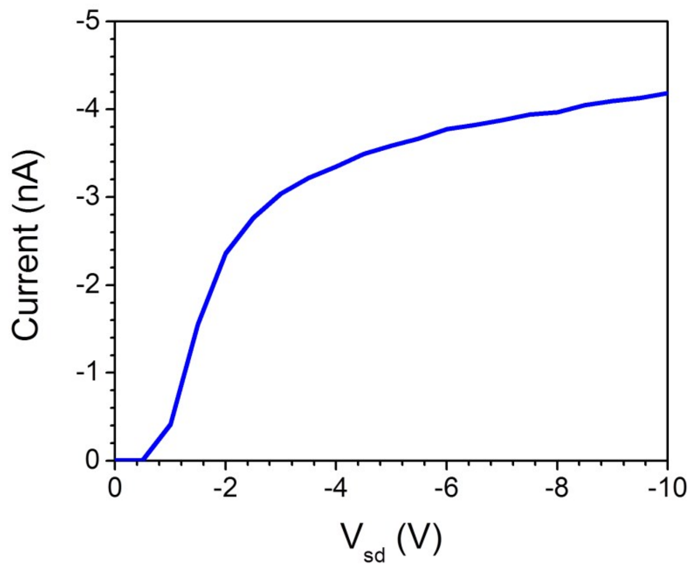

Fig. S3 The photocurrent at the transition point for SAM terminated devices as a function of the source drain voltage V_{sd} (excitation wavelength ~ 512 nm, excitation power ~ 20 μW). For the source drain voltage dependence, a negative voltage is applied to the drain side.

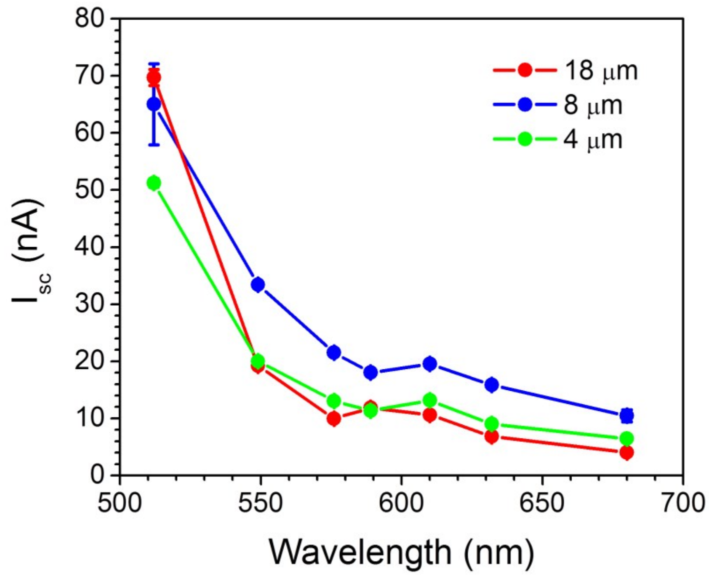

Fig. S4 The short circuit current I_{sc} as a function of the excitation wavelength for *p-i-n* diodes with the intrinsic region of three different lengths: 18, 8 and 4 μm. The excitation power is set to be 20 μW for different wavelength. The p-i-n device is fabricated in a similar way as the SOI FET, but the two contacts are doped with different type of dopants. The device is terminated with 3 nm of thermal oxide after forming gas anneal. I_{sc} increases slightly when the intrinsic region is doubled from 4 μm to 8 μm and even decreases when the intrinsic region is further increased.

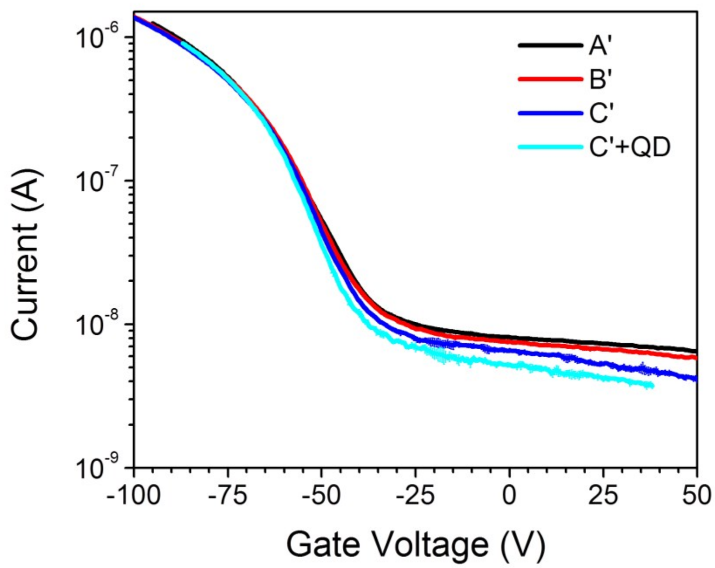

Fig. S5 I_d-V_g characteristic for the oxide terminated SOI FETs (excitation wavelength ~ 512 nm, excitation power ~ 20 μW) with and without NQDs. Different from the SAM terminated devices, the performance of different oxide terminated devices is very reproducible. After the NQD deposition, a minimal change is observed with an even slightly lower photocurrent level. For comparison purposes, the curve has been manually shifted horizontally.

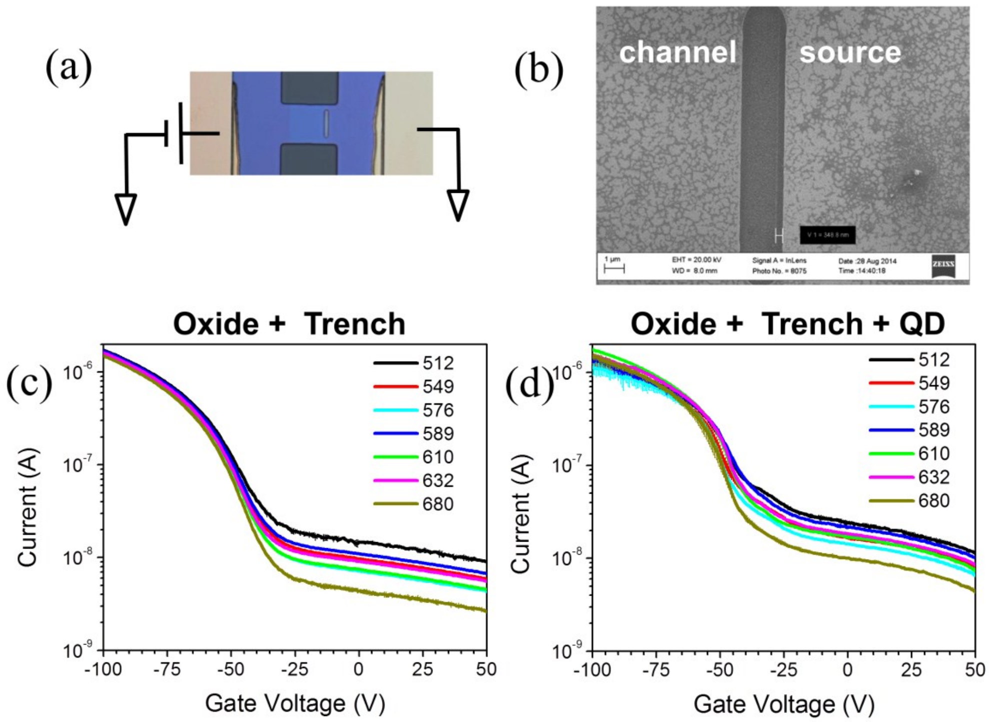

Fig. S6 An intentional trench (2 μm wide, 15 μm long and 50 nm deep) was made near the source contact to mimic the accidental trenches formed during wet chemical etching. Due to the lithography misalignment, the trench was placed a little into the doped region by ~350 nm. (a) A microscopic picture showing the device channel region with the trench made near the source contact. Also shown is the measurement configuration. (b) SEM image of the trench after the NQD deposition. Clearly, the trench was filled with NQDs and the surface of the channel region is covered with an almost continuous closely packed NQD film. I_d-V_g curve of the oxide terminated device with the trench only (c) and after NQDs are added (d). The current level is clearly increased after the NQD deposition by only several tens of nA. When the polarity of the measurement is switched (the trench is now near the drain contact), the same increase of the photocurrent is observed but the magnitude of the photocurrent both before and after the QD deposition is smaller.