Extracting Bulk-Like Semiconductor Parameters from the Characterization of Colloidal Quantum Dot Film Photoconductors

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Supporting Information.

Figure S1

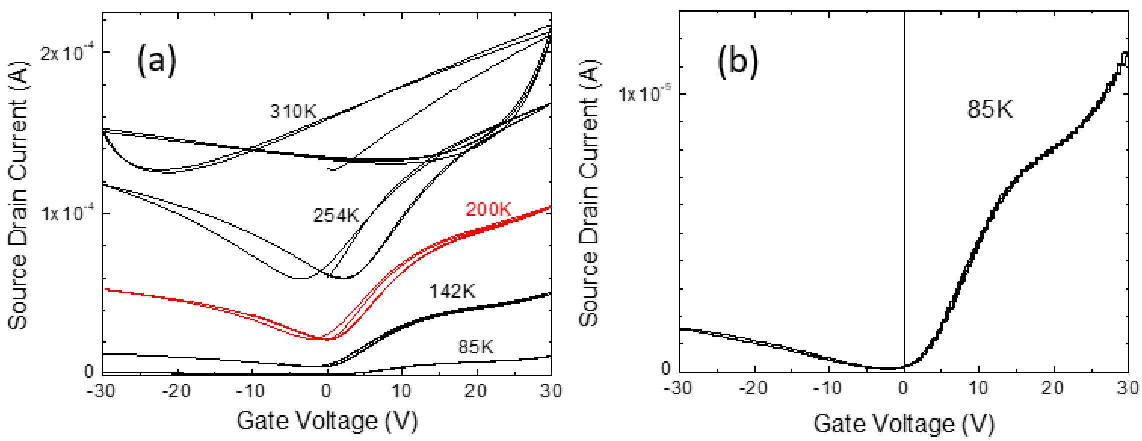

Figure S1:(a) FET data of the sample discussed in the main text. The FET response shows a significant hysteresis down to about 200K. The gate scan rate is 3V/s. Above 200K, the upper and lower mobility values are taken as the steepest slopes on forward and backward scans. (b) FET data at 85K showing a small n-type doping.

Figure S2

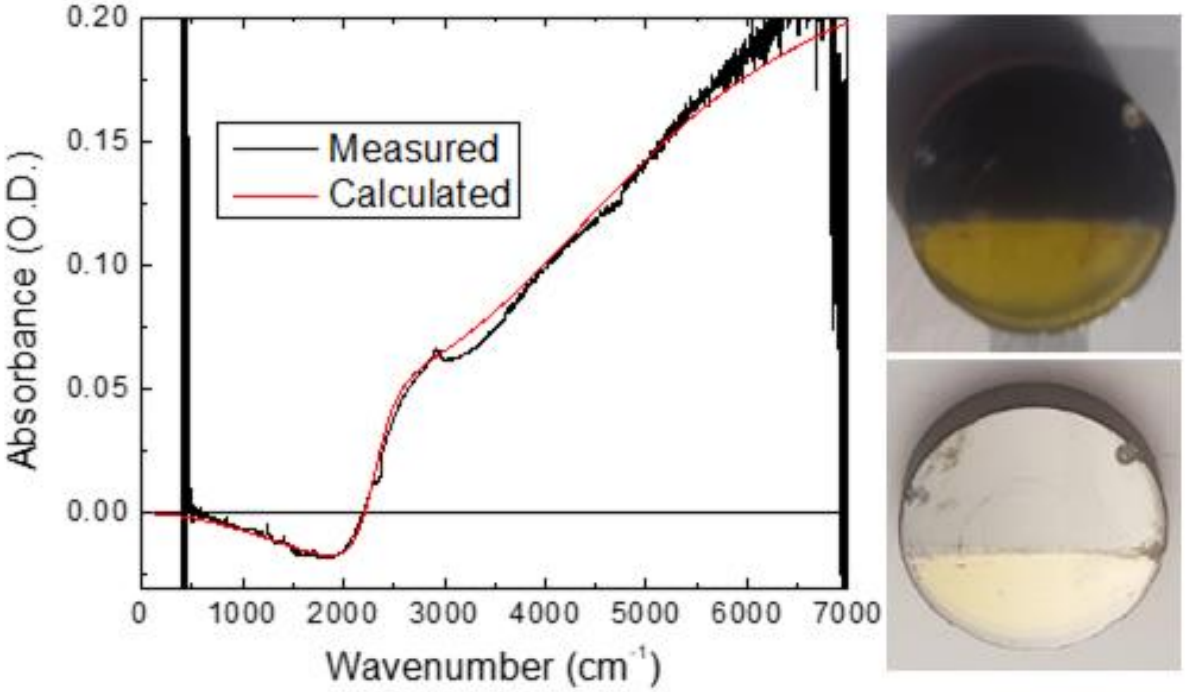

Figure S2: Absorbance of a film of CQDs on a ZnSe window, normalized to the transmission of the clean ZnSe window. The CQDs are similar to the ones used in the main text but with a gap of 2300cm^{-1} at room temperature. The film thickness measured at several points over an area of 0.5 cm^2 is within 430 and 410 nm, and taken to be 420nm±10nm. The ZnSe index of refraction is taken as 2.41. The red curve is calculated with an index of refraction of the CQD film taken as $2.25 + \frac{0.13i}{e^{(\nu-2300)/110}+1}$, with an estimated maximum error of ±0.1 for the real part and 0.01 for the imaginary parts. Photographs of the film on the ZnSe window, taken at two different angles are shown on the right

Figure S3

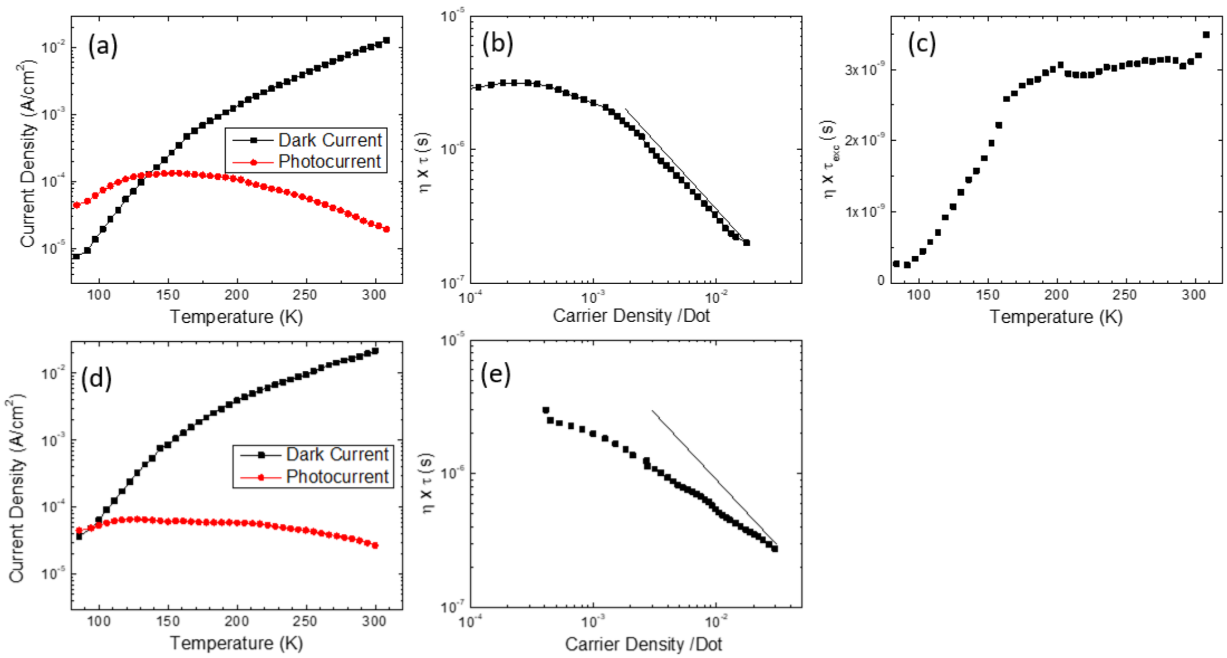

Figure S3: Similar measurements as in the main text but on a sample of 150nm thickness and made with "aggregated" HgTe CQDs. The mobility (not shown) is about 3 times smaller than the sample in the main text, but with the same band gap of 2500cm^{-1} at room temperature (a) Sample measured on day 1 shows the same behavior as the sample in the main text, with increasing photocurrent in proportion to the decreasing dark current above 150-200K. (b) The extracted carrier lifetime varies also inversely with the carrier number over an order of magnitude, consistent with the lifetime being dominated by recombination limited lifetime above 200K. (c) The extracted exciton lifetime is also similar to the value obtained for the sample in the main text and nearly constant down to 150K. (d) After 6 days exposure to air and rinsed once more with EdT/HCl/IPA cross linking solution, the sample shows a weaker temperature dependence of the photocurrent. (e) The carrier lifetime still increases with reduced carrier density, but it is no longer inversely proportional to the carrier density. Upon extended air exposure, the lifetime is therefore no longer dominated by geminate recombination even at 300K.

Figure S4

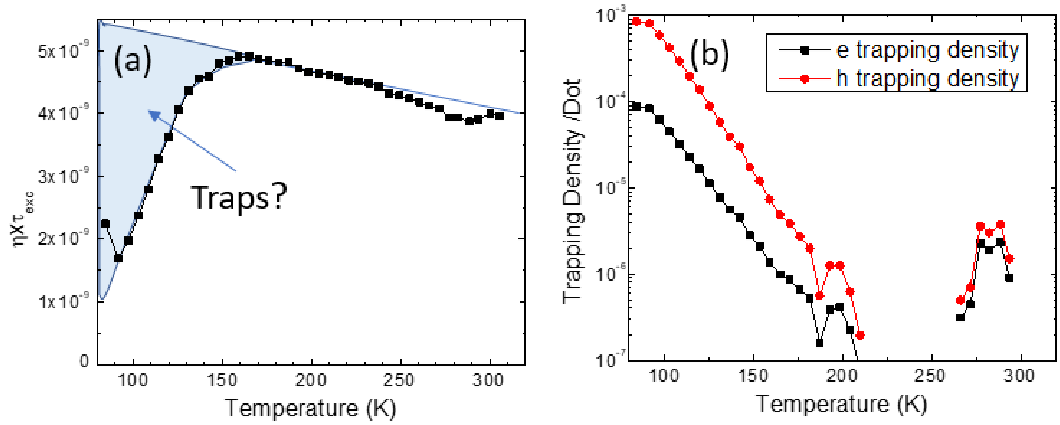

Figure S4: Sample described in the main text. a) Using a linear temperature fit of the exciton lifetime, the leftover decay is tentatively assigned to traps. b) The deduced number of traps increases with reducing temperature, due to the reduced mobility, but the overall number remains less than 10^{-3}/dot.