Supporting Information

Solvent-triggered Self-assembly of CdTe Quantum Dots into Flat Ribbons

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Fig. S1 shows a TEM image (250×250 nm) of the raw CdTe QD colloid. We measured the sizes of 100 particles in this image and found a mean particle diameter of 4.1±0.2 nm from a Gaussian fit of the histogram.

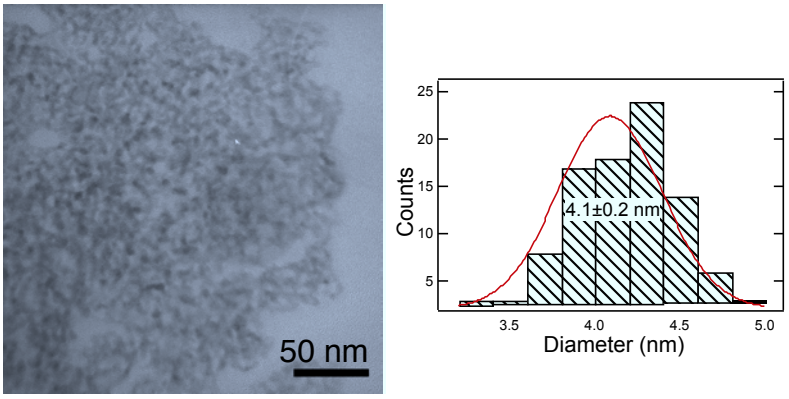

Figure S1: TEM image of raw CdTe QD colloid. The histogram was generated from 100 size measurements of QDs in this image. The red curve is a Gaussian fit of the size distribution yielding a mean particle diameter of 4.1±0.2 nm.

Purification of the raw QD colloid was monitored with UV-vis and PL to select the solvent and dilution ratio. An aliquot of 1 mL of raw colloid was added to five different volumes of acetone (1-5 mL). After contacting for 4 h, the QD aggregates were collected by centrifugation, rinsed with IPA, and vacuum dried. The aggregates were redispersed in 1 ml of water. A second identical purification was done ending with redispersing the QDs in 1 mL of DI water. The same procedure was used to purify the raw colloid using methanol, but the second purification was not possible because QDs did not aggregate.

Fig. S2 shows the UV-vis and PL spectra as a function of solvent and

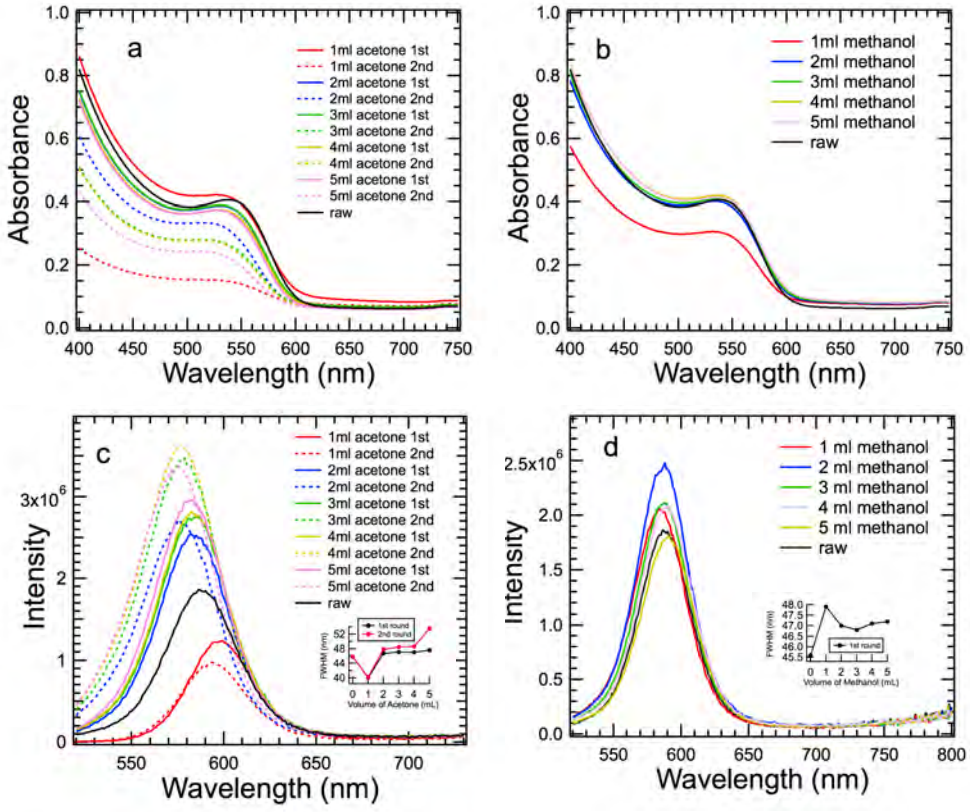

Figure S2: UV-vis and PL spectra for 1 mL of raw CdTe-TGA QD colloid purified twice with different amounts (1-5 mL) of acetone and methanol. UV-vis spectra for (a) acetone and (b) methanol. PL spectra for (a) acetone and (b) methanol. The black solid lines show the raw colloid in each case. The other solid lines are for the first purification, and the dotted lines are for the second purification. Inset in (c) and (d) shows the FWHM of PL peak versus the amount of solvent used for purification. Volume 0 represents the raw colloid.

dilution ratio. The UV-vis spectra for acetone show a small blue-shift from 545 to 540 nm and a slight decrease in intensity after the first purification except for the 1:1 ratio (Fig. S2a). The absorbance dropped much more after the second purification, with the 1:1 ratio yielding the largest change. The peaks shifted farther into the blue to ∼530 nm, except for the 1:1 ratio, which did not shift. The UV-vis spectra for methanol were the same before and after the first and only purification, except for the 1:1 dilution ratio whose absorbance dropped (Fig. S2b). The peaks did not blue shift as with acetone.

PL spectra for acetone-purified QDs in Fig. S2c show a continuous intensity increase and blue shift for dilution ratios greater than 1:2 (raw colloid to acetone)—the more acetone used, the larger the blue shift observed. The dilution ratio of 1:1 decreased in intensity and exhibited a red shift compared to the raw suspension after the first purification. The intensity decreased but the peak shifted blue after the second purification. The variation of the full width at half maximum (FWHM) with the volume of acetone used is shown in the inset of Fig. S2c. Compared to the raw suspension with a FWHM of 45.6 nm, a 1:1 ratio exhibited a lower FWHM of 39.8 nm after both purification steps, and using excess acetone the FWHM of 47-48 nm was about the same. But the FWHM increased as the dilution ratio increased, especially for the second purification.

PL spectra for methanol-purified QDs in Fig. S2d show similar intensities and peak positions before and after purification for the dilution ratios studied. Although the PL intensity changed, there was no trend with the volume of solvent used for purification. Also the FWHM of 46.8-47.9 nm was about the same after the first purification except for the 1:1 dilution ratio as shown in

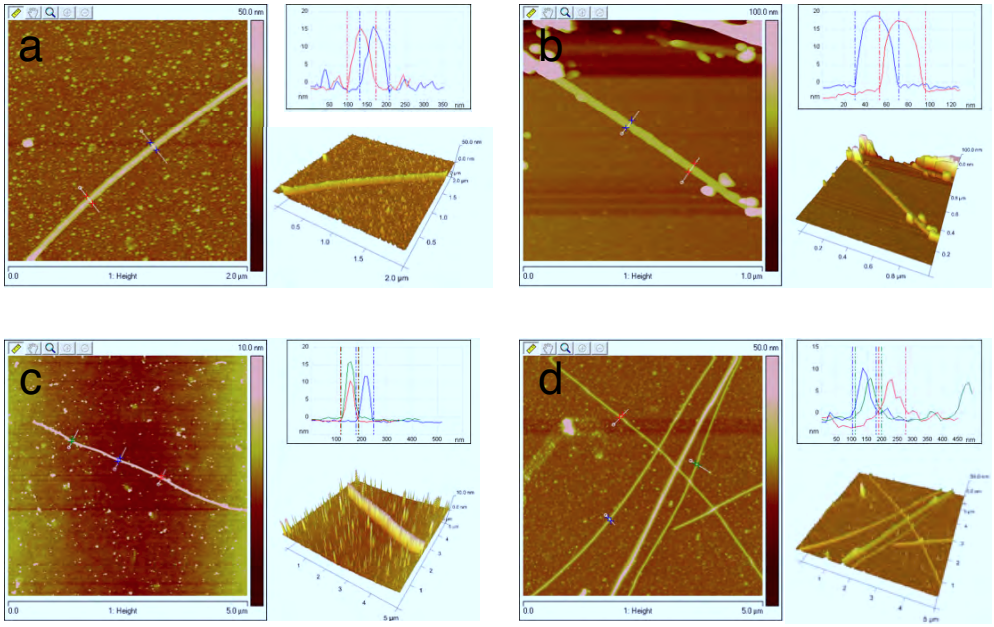

Figure S3: AFM images as well as their corresponding height profiles after injecting purified QDs into a) methanol, b) IPA, and c) acetone at a dilution ratio of 1:100 (purified colloid to solvent). d) Purified QDs formed ribbons after one week in water without dilution.

the inset of Fig. S2d.

Acetone was chosen as the purification solvent because of the increase in the PL intensity and blue shift, which we attribute to the passivation of defect sites on the surface of the QDs by S as described in the paper. A dilution ratio of 1:3 raw colloid to acetone was chosen because it was the best tradeoff between maximizing both the UV-vis and PL peak intensities.

AFM images of ribbons formed by injecting purified QDs into methanol, IPA, and acetone at a dilution ratio of 1:100 (purified colloid to solvent) and their corresponding height profiles are shown in Fig. S3a-c. The height and width is 15 nm by 75 nm for the ribbon formed in methanol; 18 nm by 40 nm

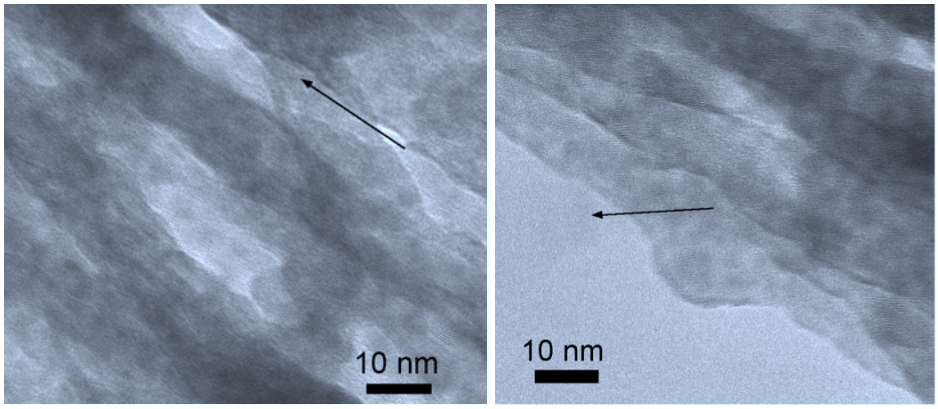

Figure S4: Close inspection of TEM images of ribbons and nodules formed by injecting the purified colloid in IPA show that individual QDs fused together. The arrows indicate the directional of lattice planes.

for the ribbon formed in IPA; and 10-15 nm by 66 nm for the ribbon formed in acetone. Also note the clusters or nodules at the ends of the ribbon formed in IPA shown in the three-dimensional image. Fig. S3d shows ribbons that are 8-10 nm high and 80 nm wide formed by leaving the purified colloid in water for one week without the large dilution.

TEM images show the direction of the lattice planes for QDs within ribbons and nodules formed by injecting the purified colloid into IPA (Fig. S4). The similar directions show that single QDs fused together to form a bulk-like structure. The SEM image in Fig. S5 shows the ribbons formed by storing the purified colloid for 20 days in water without the high dilution ratio. The smooth and straight appearance of these ribbons is close to those formed by injecting purified QDs into methanol. No clusters or branches were found.

Fig. S6 shows EDS mapping of nanoflowers formed by injecting the purified colloid into acetone. The structures contain both Cd and S, but lack

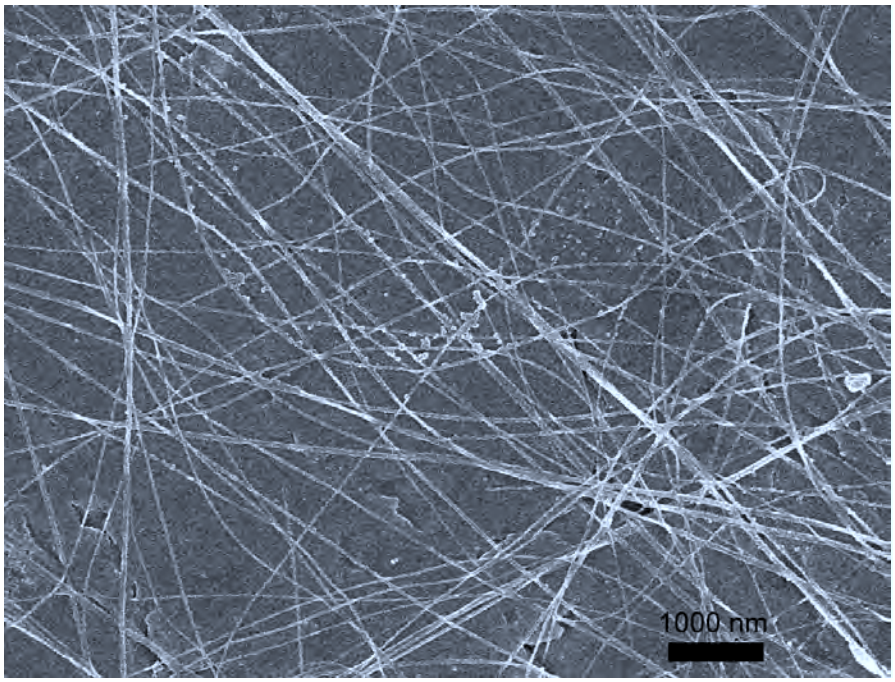

Figure S5: SEM image of ribbons formed by the purified CdTe QD colloid after 20 days in water.

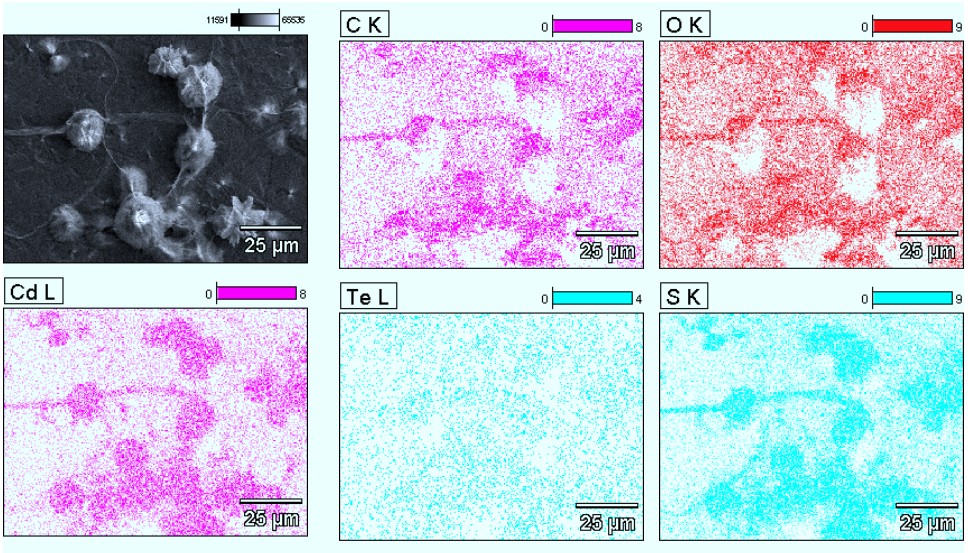

Figure S6: EDS mapping of nanoflowers formed by injecting purified CdTe-TGA colloid into acetone and contacting for 20 days. The corresponding SEM image is in the upper left.

Te, C, and O. The Te is spread over the image indicating it dissolved. As described in the paper, the Te initially in the CdTe dots within the ribbons dissolved as the TGA ligand was removed creating vacancies that were filled by S from decomposition of the ligand.