CdTe/CdS/ZnS synthesis

- 1. Wash CdTe/CdS with 1:1 volume ratio methanol for 15 min at 15000 rpm.
- 2. Re-disperse in 100 ul of DI water.
- 3. Add 10 uL Zn(NO3)2 (25mM) /MPA (50 mM) and 5 uL NaOH to the re-dispersed QD solution.
- 4. Heat the mixture for 70 mins to get QD with approximately 5 nm diameter.

CdTe-GSH synthesis

- 1. Make 2 ml 12.5 mg/ml NaBH4. Weigh 40 mg Te. Dissolve in pH 9 DI water to make 0.1M NaHTe solution. Leave 6hrs for the reaction to finish.(NaHTe/CdCl2-GSH precursor synthesis
- 2. [MW:NaBH4 37.83; Te 127.6] [Reaction: \$\$4NaBH_{{4}} + 2Te +7H_{{2}}0 2NaHTe + Na_{{2}}B_{{4}}O_{{7}} + 14H_{{2}}\$\$])
- 3. Make 1 mM CdCl2-GHS solution in pH 9 (Cd:GSH=1:2). **Purge using nitrogen for 10min to obtain nitrogen saturated CdCl2-GHS.**([MW: CdCl2 183.32; GHS 307.32])
- 4. Mix 200 ul CdCl2-GSH solution with 0.5ul NaHTe in **ice bath**. Add 20ul 1mM DNA. (Cd:Te:GSH:DNA=10:5:20:1) All the mixing must be conducted in heating block at 90 C.
- 5. Incubate for (0.5hr:??nm)(1hr:6nm)(1.5hr:??nm)(2hr:??nm)(2.5hr:??nm) washing
- 6. Add 0.1V 3M NaCl and 2V Isopropanol (or methane).
- 7. Benchtopcentrifugefor 5 min at 5000rpm.
- 8. Remove the liquid and leave the brown pellet (CdTe).
- 9. Redisperse with 200ul 1X TAE buffer using bath-sonication for 1 min.

CdS-DNA synthesis

- 1. Make 5mM precursors (Na2S and CdCl2) [MW: Na2S 240.18, CdCl2 183.32]
- 2. Mix 30ul of 1mM DNA and 120ul 5mM CdCl2 at 150 rpm.
- 3. Place mixture in water bath (60 C)
- 4. Add 60ul 5mM Na2S at 1000 rpm.
- 5. Add 100ul TAE buffer. Incubate at 150 rpm for 6 hrs. washing
- 6. Add 300ul 3M Nacl and 300ul Isopropanol
- 7. Benchtopcentrifuge for 4 min at 15000rpm.
- 8. Remove the liquid and leave the yellow pellet (CdS).
- 9. Redispersewith 200ul 1X TAE buffer using bath-sonication for 1 min.

DNA/MPA capped CdS shell growth: Purchased CdTe Core from Sigma Aldrich

- 1. Dissolve purified CdTe core and determine the concentration. **The following steps are based on 2.5uM Core CdTe concentration.**
- 2. Make 25mM Cd(NO3)2 solution by adding 77.12 mg Cd(NO3)2 [MW:Cd(NO3)2 = 308.48] in 10mL DI water.

- 3. Make 50mM MPA solution by adding 45ul 11M MPA in 10mL DI. Do not mix Cd/MPA before experiments and leave for a long time!!! The coordination complex will decompose under light/room temperature. This will leave too much CdS in the solution.
- 4. Mix 100 ul of 2.5 uM CdTe core, 5 ul Cd(NO3)2 and 5 ul MPA and 2 ul 1 mM NaOH. Place in heater for 45 mins under 90 C. The color of the QD will become orange.
- 5. Add another 5 ul Cd(NO3)2 and 5 ul (MPA) to the solution. Add 50 ul 100 uM functional DNA (like DNAzyme) to the solution. Place in heater for another 60 mins. The DNA to QD ratio is 20:1. The color of the QD will be red. washing
- 6. Load the reacted solution into a 0.5mL Amicon filter (MWCO 30kDa) and add 400ul DI water.
- 7. Bench top centrifuge for 3.5 min at 5000 g. Repeat the process for 4 times.
- 8. Reverse spin for 2 min at 2000rpm. The obtained DNA-QD has a DNA:QD ratio of 10:1.er

DNA/MPA capped CdS shell growth: snthesized CdTe Core

- 1. Make 25mM CdCl2-MPA solution (Cd:MPA=1:2). Adjust pH to 12.2.
- 2. Add 2ul 1mM DNA, 10ul CdCl2-MPA solution and 100ul CdTe core solution to 300ul DI water. Adjust pH to 12.2. The DNA to QD ratio now is 200:1.
- 3. Put the sample in block heater at 90C for 50min. CdS/CdTe QD with emission peak at 640nm should form.

MPA capped CdTe core purification: Purchased CdTe Core from Sigma Aldrich

- 1. Mix 100ul 3M Nacl, 100ul Isopropanol and 100 CdTe core solution.
- 2. Benchtop centrifuge for 4 min at 15000rpm.
- 3. Remove the liquid and leave the yellow pellet (CdTe).
- 4. Re-disperse with 100ul 1X TAE buffer using bath-sonication for 1 min.

MPA capped CdTe Core: TeO3 as source

- 1. Make 200ml 5mM Cd(NO3)2 solution.
- 2. Add 150ul MPA into Cd(NO3)2 solution (Cd:MPA=1:2). Adjust pH to 10.5 using NaOH.
- 3. Add 50.8 mg of K2TeO3 into the solution. (Cd:MPA:TeO3 = 1:1:0.2)[MW K2TeO3 = 253.79]
- 4. Add 378.3mg of NaBH4 into the solution. (NaBH4:Cd = 10:1)[MW:NaBH4 37.83]
- 5. Incubate to form CdTe with desired size: (5a). Leave in 4 C overnight. or (5b). Heat under 90 C.

MPA capped CdTe Core: Te as source

1. Make 2 ml 12.5mg/ml NaBH4. Weigh 25 mg \$\$NaBH_4\$\$ and add to 2 ml DI water in a 4 mL vial. Cover the vial with a septum. Insert a inlet and outlet needle with the inlet needle

- merged into the liquid. Connect nitrogen to the inlet needle and purge the solution for 10 min.
- 2. Weigh 40 mg Te and add to a 5 ml reaction vial. Put a stirrer into the vial. Seal the vial by capping with an o-ring and septum. Wrap additional parafilm around the cap to avoid leakage. Insert inlet and outlet needle. Connect nitrogen to the inlet needle to purge the vial for 5 min.
- 3. Transfer \$\$NaBH_4\$\$ solution to Te powerder vial with a syringe. Make sure there is a nitrogen gas layer in the transfer syringe to block the air from the solution. Connect a nitrogen baloon to the reaction vial through the inlet needle and a deflated baloon (to serve as waste) to the outlet needle. Leave 6hrs to obtain 0.1 M \$\$NaHTe\$\$ solution. [MW:NaBH4 37.83; Te 127.6]
- 4. Make 200ml 5mM CdCl2 solution.
- 5. Add 150ul MPA into CdCl2 solution (Cd:MPA=1:2). Adjust pH to 12.2. **Purge using nitrogen for 10min to obtain nitrogen saturated CdCl2-MPA.** [MW: CdCl2 183.32; MPA 106.14]
- 6. Add 1 ml NaHTe into 200ml CdCl2-MPA solution at 4C. Leave at 4C overnight for the 1.6nm CdTe core to form.