Last Update: 22 March 2023

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.