Physics and chemistry of nanostructures

Progress Navolchi project

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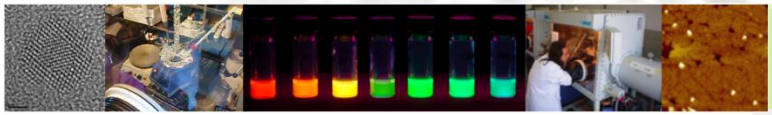


Outline

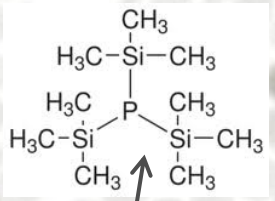
- People
- Materials
- Processing
- Properties
- Devices
  - Absorbance of functionalized waveguides
- Planning of future work

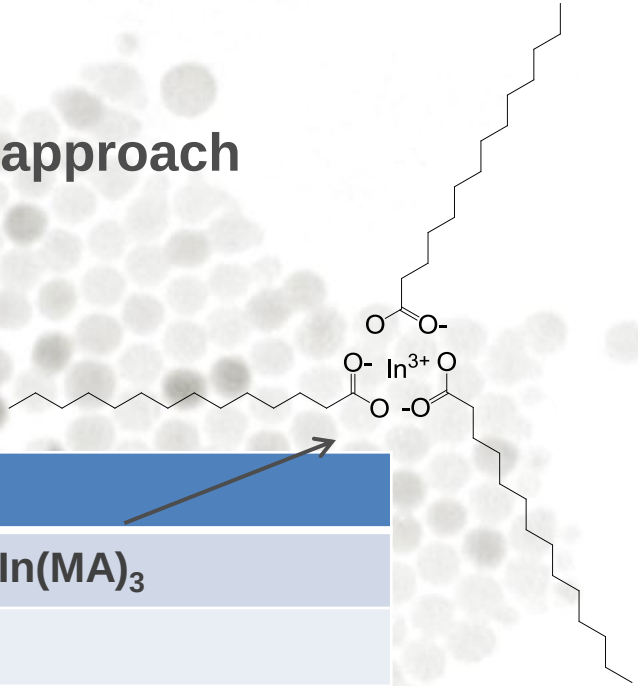
Materials

- InP/CdS
  - Why?
    - Type 2 heterostructure with emission wavelength > 1000 nm
  - Challenges
    - CdS shell growth seems difficult according to literature
    - Based on bulk band alignment, 1500 nm is within reach, yet no experimental evidence in literature so far
  - Current activities
    - Establish state-of-the-art InP synthesis @ Ugent
    - Push core synthesis to larger diameters
    - Develop reliable shell growth procedure

Materials

- **InP/CdS – baseline synthesis**
  - **Variation on published hot injection approach**





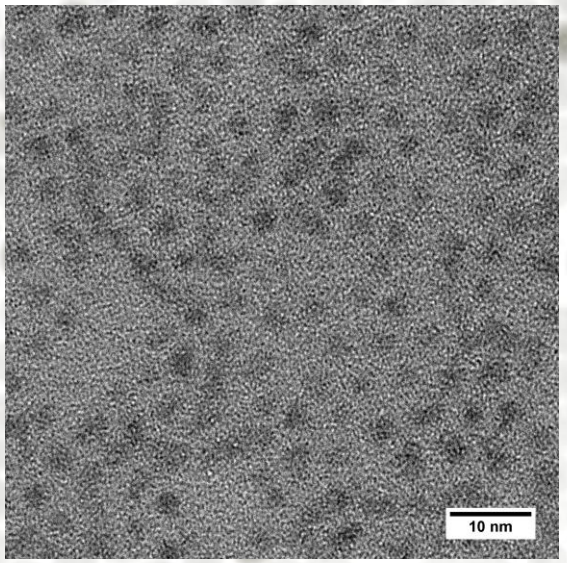
Synthesis conditions	
Precursors	$P(TMS)_3$ and $In(MA)_3$
In:P:Octylamine:Myristic Acid	2:1:11:*x*
Injection Temp.	188 °C
Growth Temp.	178 °C
Reaction time	30 min

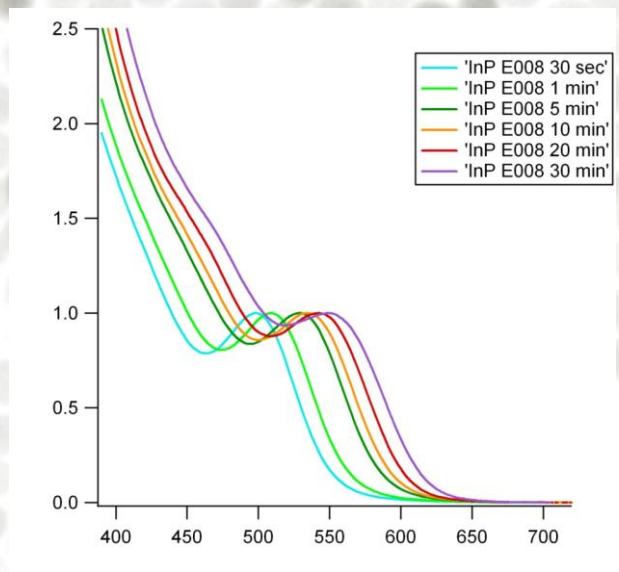
R. Xie, D. Battaglia and X. Peng; J. Am. Chem. Soc. 2007; *129*; 15432-15433

Materials

- **InP/CdS – baseline synthesis**
  - **Typical result:**

In : P: octylamine : MA = 0.4 : 0.2 : 2.2 : 1.70



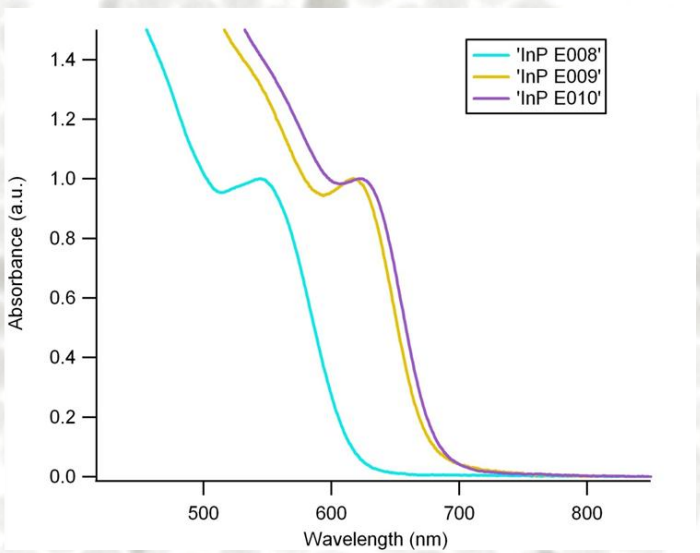


R. Xie, D. Battaglia and X. Peng; J. Am. Chem. Soc. 2007; *129*; 15432-15433

Materials

- **InP/CdS – baseline synthesis**
  - **Size tuning *via* myristic acid concentration:**

Sample	In:MA ratio	Abs. max (nm)
E003	0.4:1.60	485
E007	0.4:1.65	513
E008	0.4:1.70	549
E009	0.4:1.75	615
E010	0.4:1.90	622

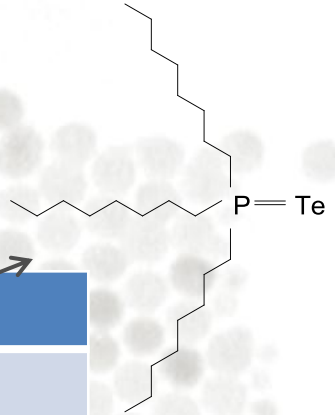


Required starting point to push InP/CdS core/shell QDs towards 1300 and 1500 nm

R. Xie, D. Battaglia and X. Peng; J. Am. Chem. Soc. 2007; *129*; 15432-15433

Materials

- HgTe – baseline synthetis (under development)
  - Variation on published hot injection approach

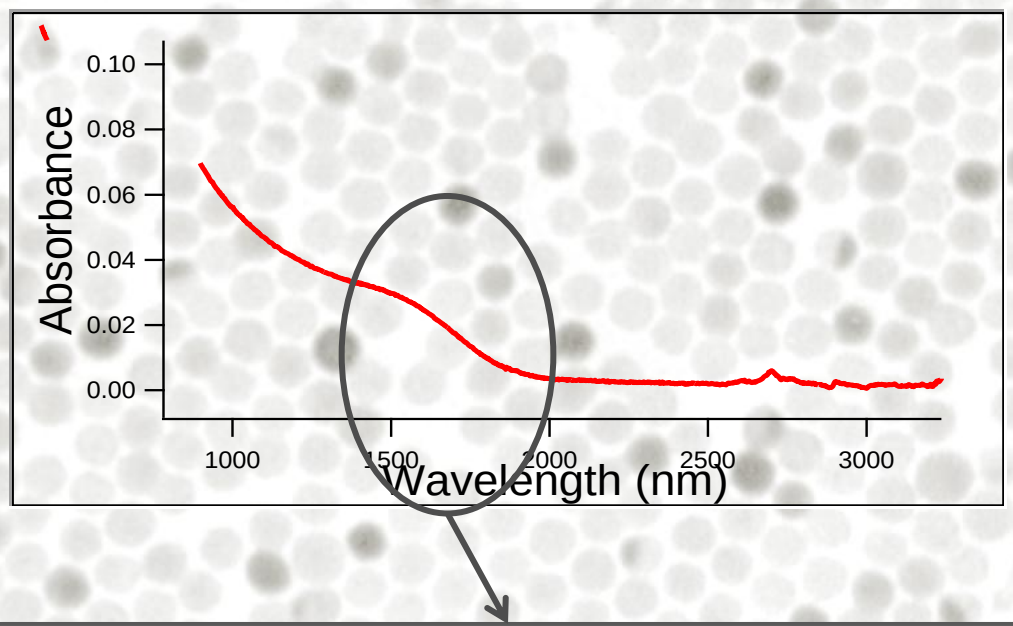


Synthesis conditions	
Precursors	$HgCl_2$ and TOP-Te
Hg:Te	1:1:11:*x*
Injection Temp.	60 °C
Growth Temp.	60 °C
Reaction time	15 min

Keuleyan et al., J. Am. Chem. Soc. 2011; *133*; 16422-16424

Materials

- HgTe – baseline synthetis
  - Initial result:



Band gap in 1500-2000 nm range
=
good starting point to cover wavelengths in 1300-1600 nm range

R. Xie, D. Battaglia and X. Peng; J. Am. Chem. Soc. 2007; *129*; 15432-15433

Future work

- InP
  - Further push core synthesis to larger sizes
  - Development of CdS shell growth procedure
  - Optical characterization
- HgTe
  - Enhance size dispersion
  - Optimize size control in the required wavelength range
  - Optical characterization