

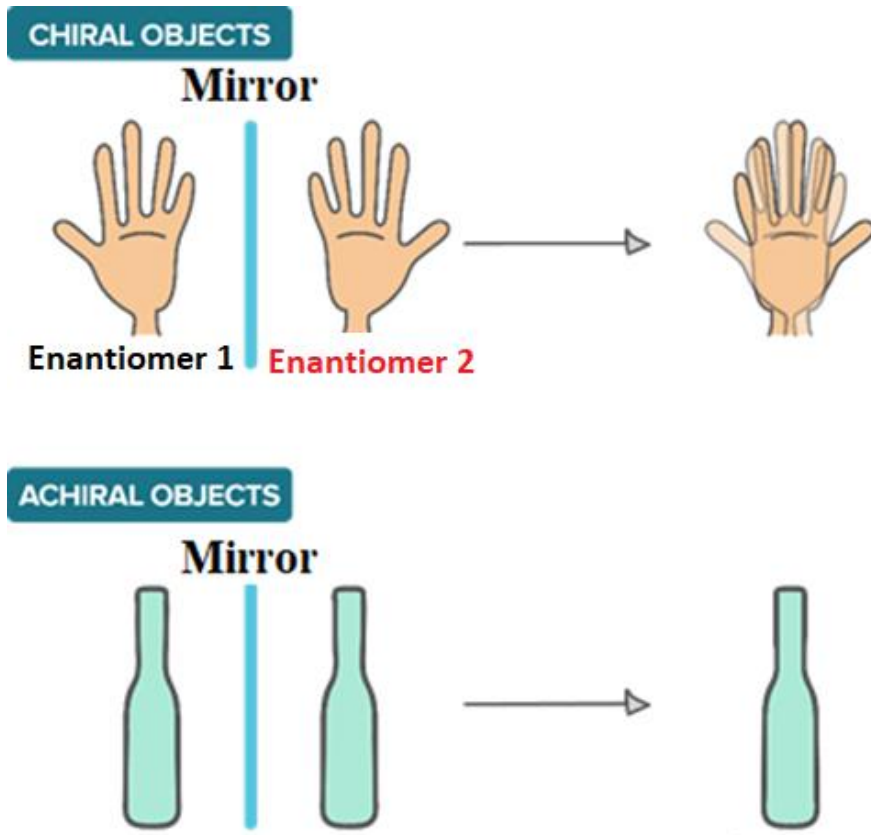


Anastasia Visheratina, V. Kuznetsova, F. Purcell-Milton, A. Orlova,
A. Fedorov, A. Baranov, Y. Gun'ko

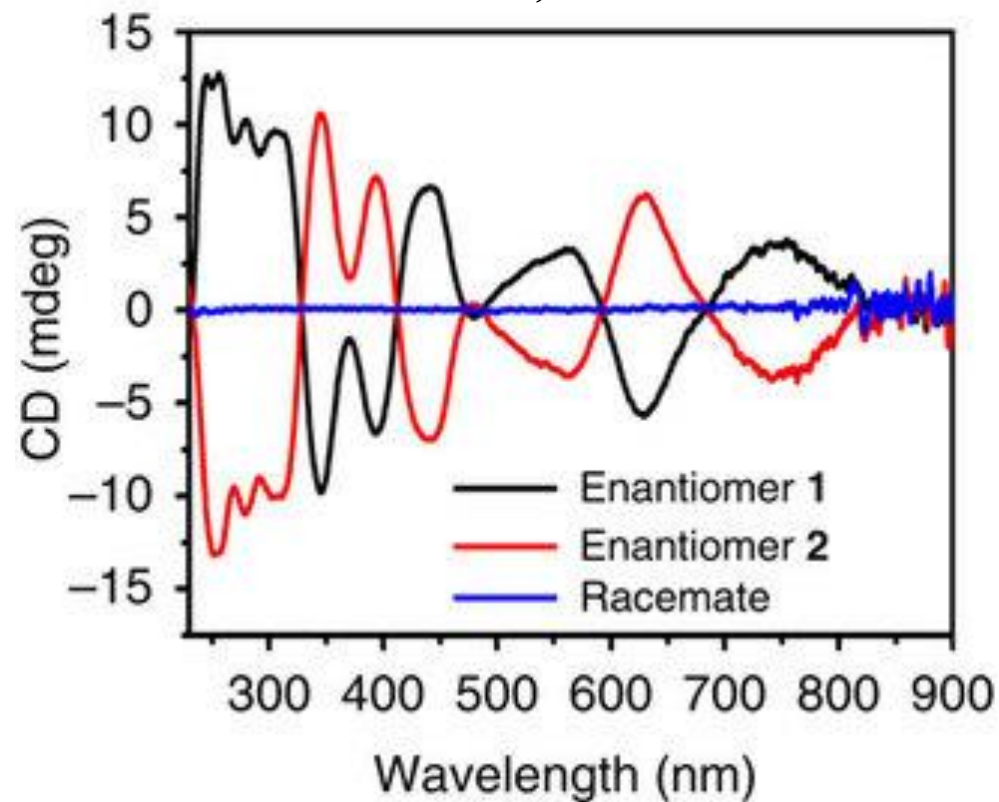
**OPTICALLY ACTIVE HYBRID
NANOSTRUCTURES BASED ON
SEMICONDUCTOR QUANTUM DOTS AND
CHIRAL MOLECULES FOR BIOMEDICINE**

OPTICAL ACTIVITY

Circular dichroism (CD) spectroscopy



$$g\text{-factor} = \frac{\Delta\epsilon}{\epsilon},$$
$$\Delta\epsilon = \epsilon_L - \epsilon_R; \quad \epsilon = \epsilon_L + \epsilon_R$$



Journal of
Chemical Education

Volume 73, Number 6
JUNE 1996

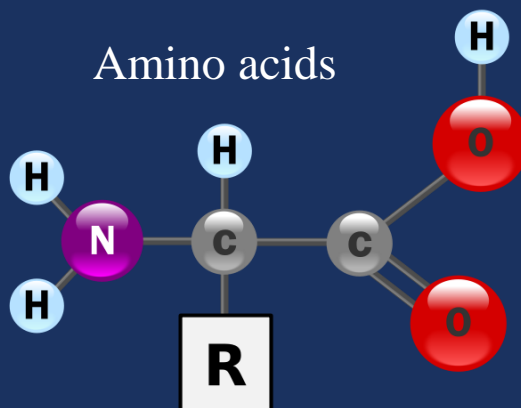


When Drug Molecules
Look in the Mirror

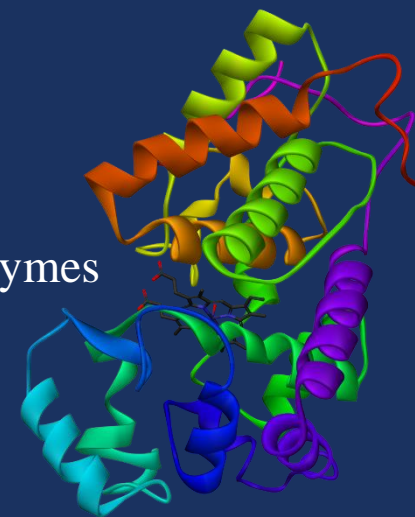
Published by the DIVISION OF CHEMICAL EDUCATION OF THE AMERICAN CHEMICAL SOCIETY



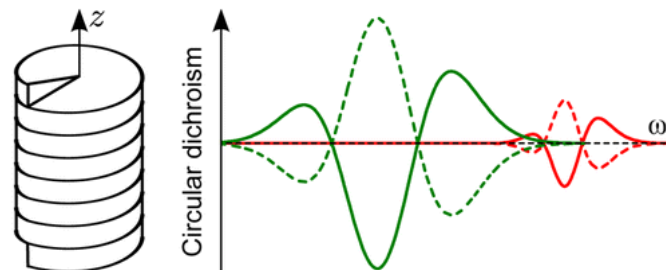
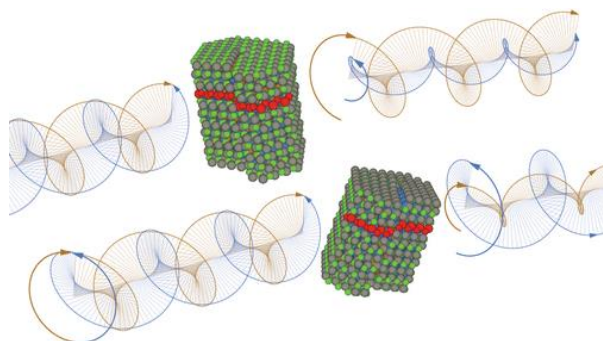
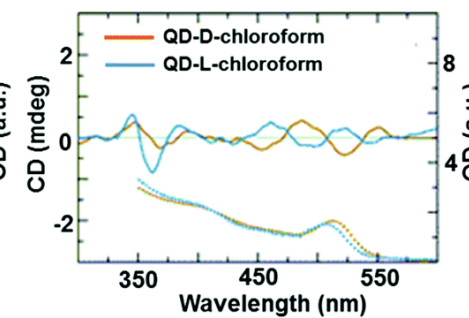
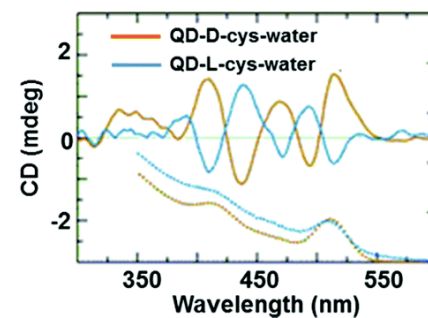
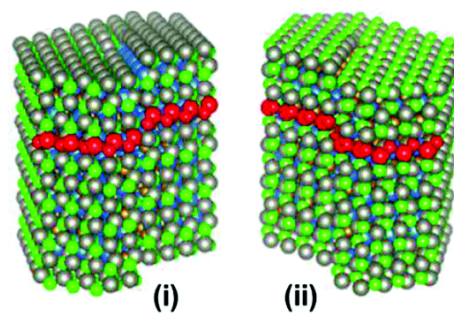
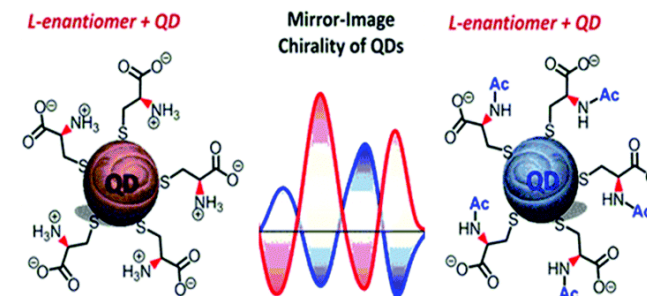
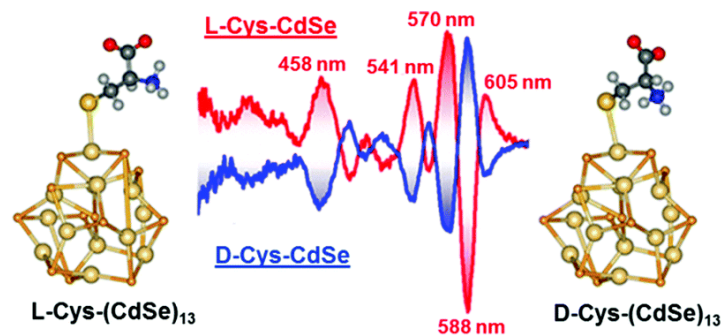
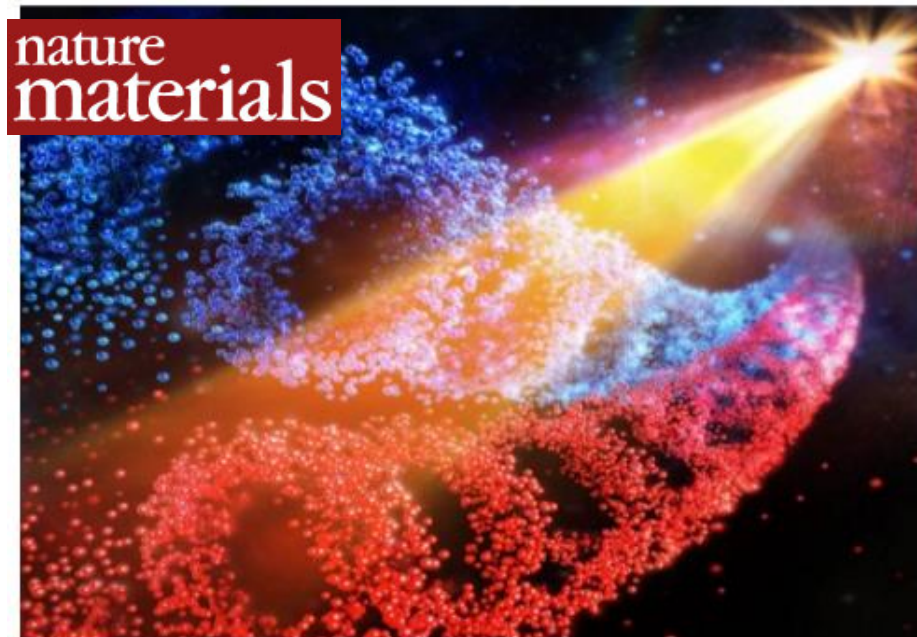
CHIRALITY IN BIOMEDICINE



Enzymes



OUR CHIRAL WORLD...AND CHIRAL NANOWORLD



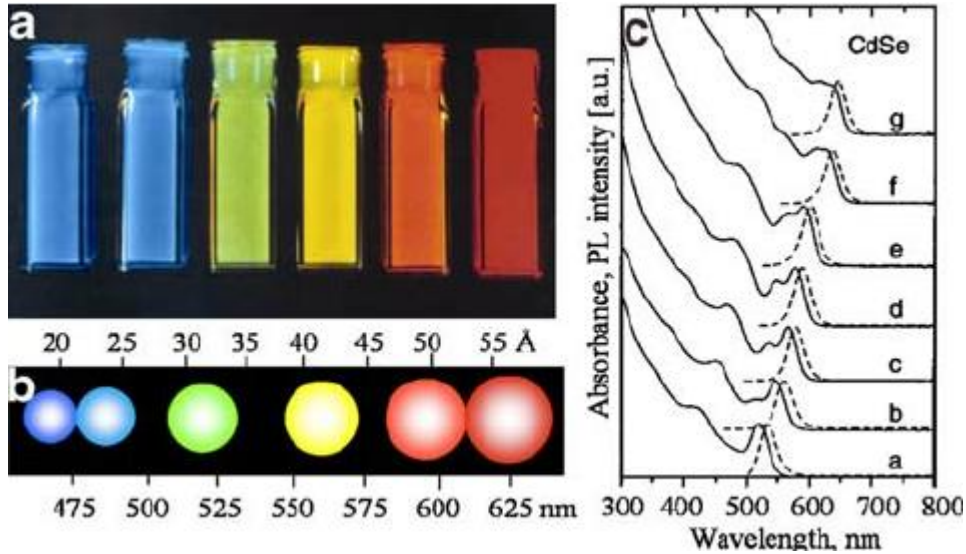
nature
COMMUNICATIONS

CHEMICAL
REVIEWS

ACS NANO

NANO LETTERS

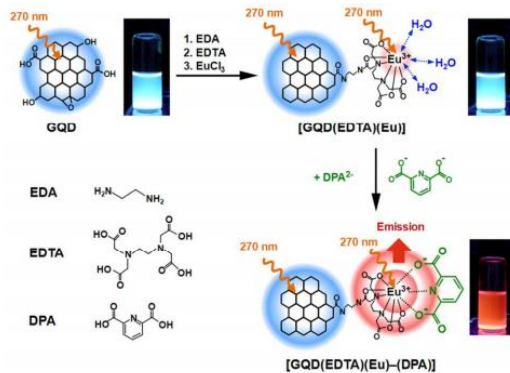
SEMICONDUCTOR QUANTUM DOTS (QDs)



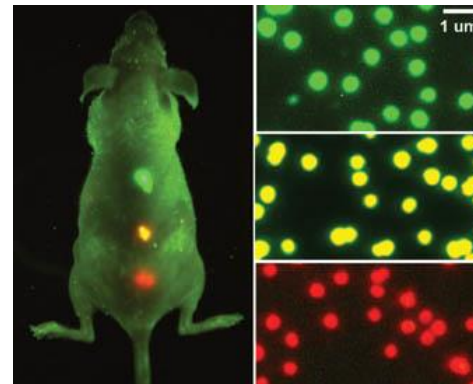
QDs properties:

- Size-depended optical properties (quantum confinement effect)
 - Narrow emission band
- High extinction coefficient in a broad spectral range
 - High photoluminescence quantum yield
- High chemical stability and photostability
 - Opportunity to surface modification

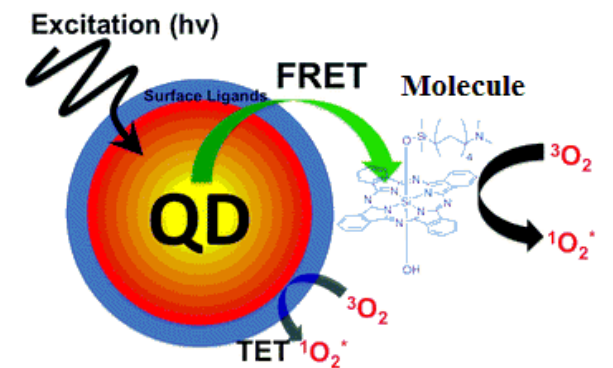
Sensors



Luminescent labels

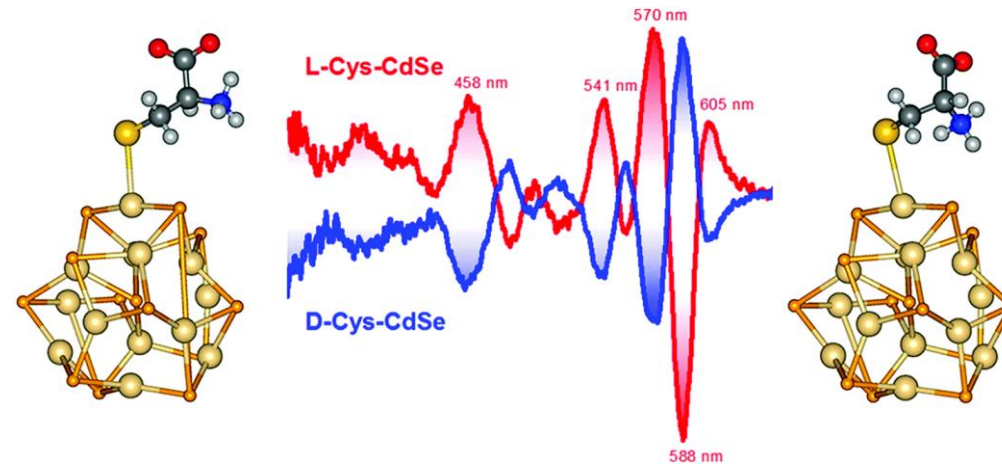


Drug delivery & Energy donors



AIM OF RESEARCH

Investigation of optical properties of hybrid nanostructures (HyNSs) based on semiconductor QDs and chiral molecules



Tohgha U. et al. ACS Nano, 7(12), 11094-11102, 2013

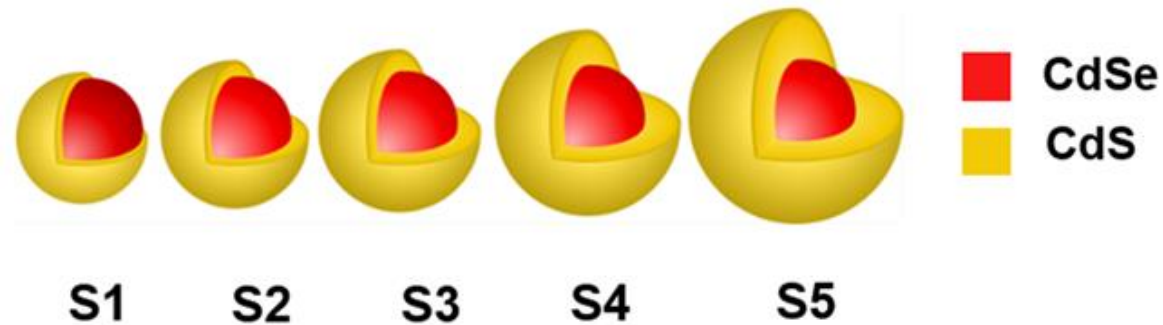
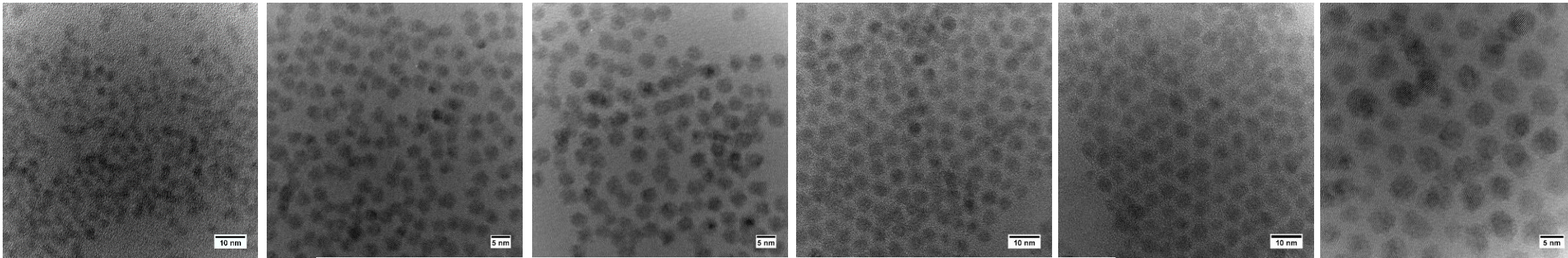
PRESENTATION OUTLINE

1. Optical properties of QDs in HyNSs
2. Optical properties of chiral molecule in HyNSs
3. Interactions of chiral HyNSs with surrounding environment

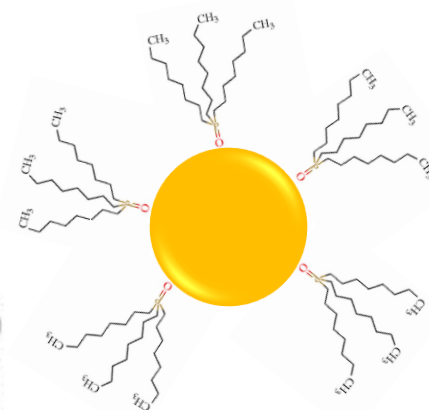
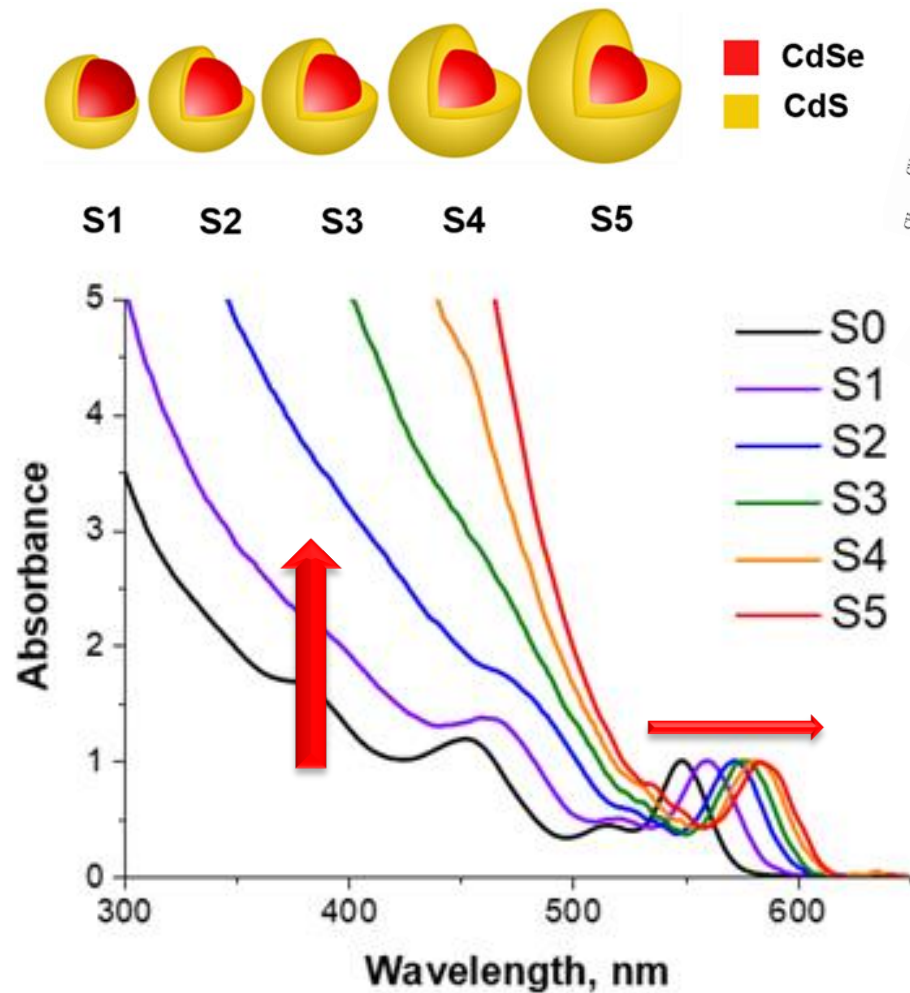
1. OPTICAL PROPERTIES OF QDs IN HYNSS

CdSe/CdS QDs with different CdS shell thickness

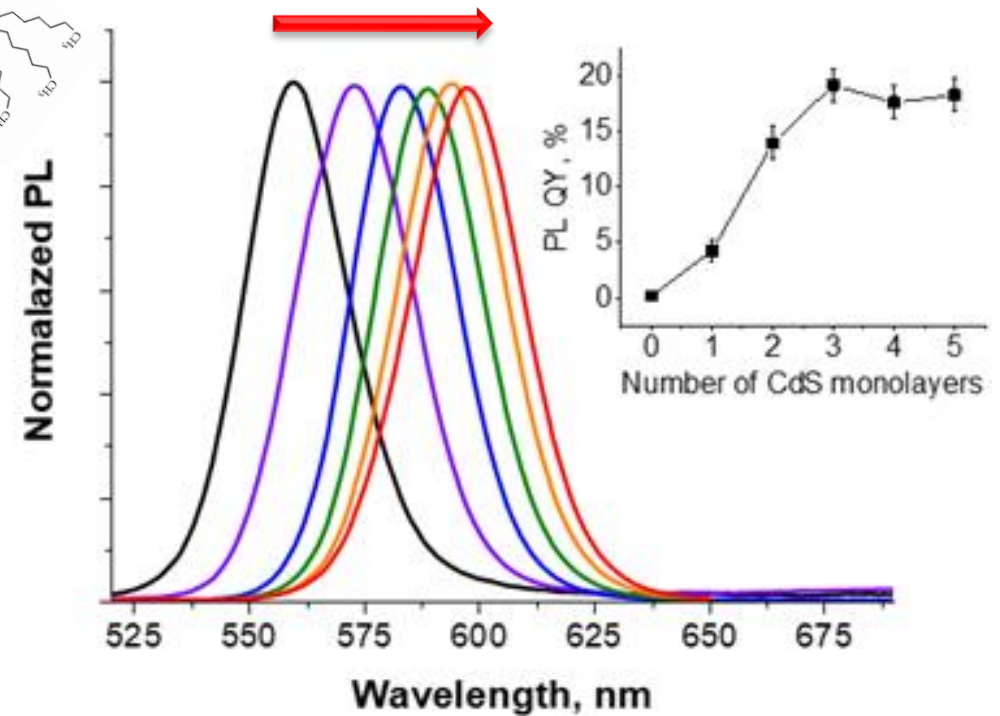
In nm	S0	S1	S2	S3	S4	S5
Diameter	2.8 ± 0.4	3.7 ± 0.4	4.1 ± 0.4	4.5 ± 0.5	4.9 ± 0.6	5.2 ± 0.8
Shell thickness	0	0.45	0.65	0.85	1.05	1.2



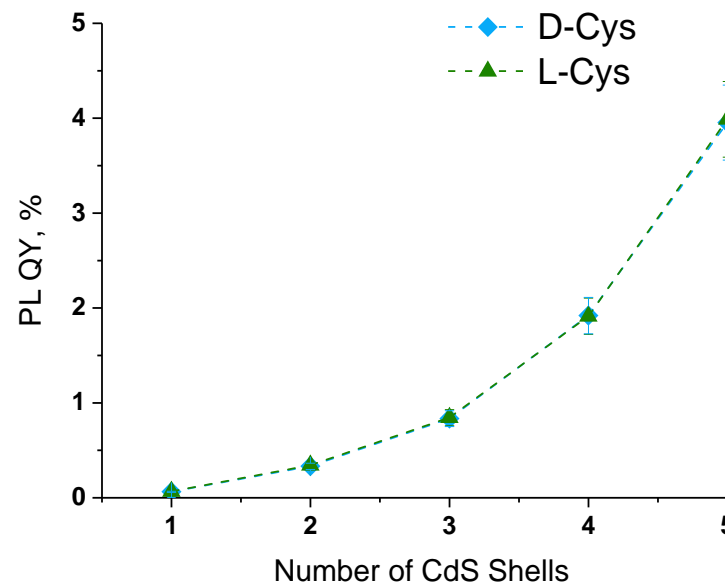
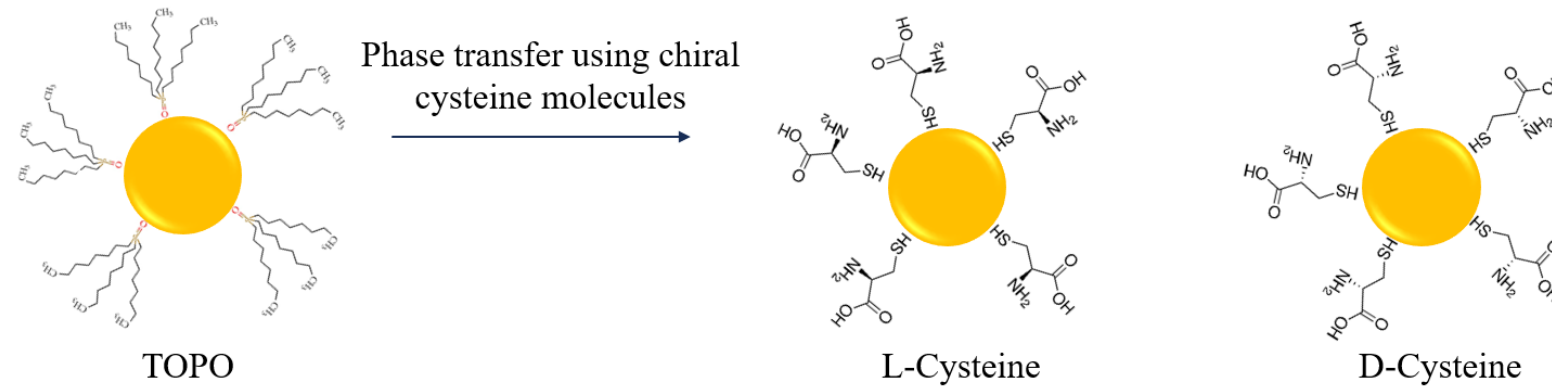
1. OPTICAL PROPERTIES OF QDs IN HYNSS



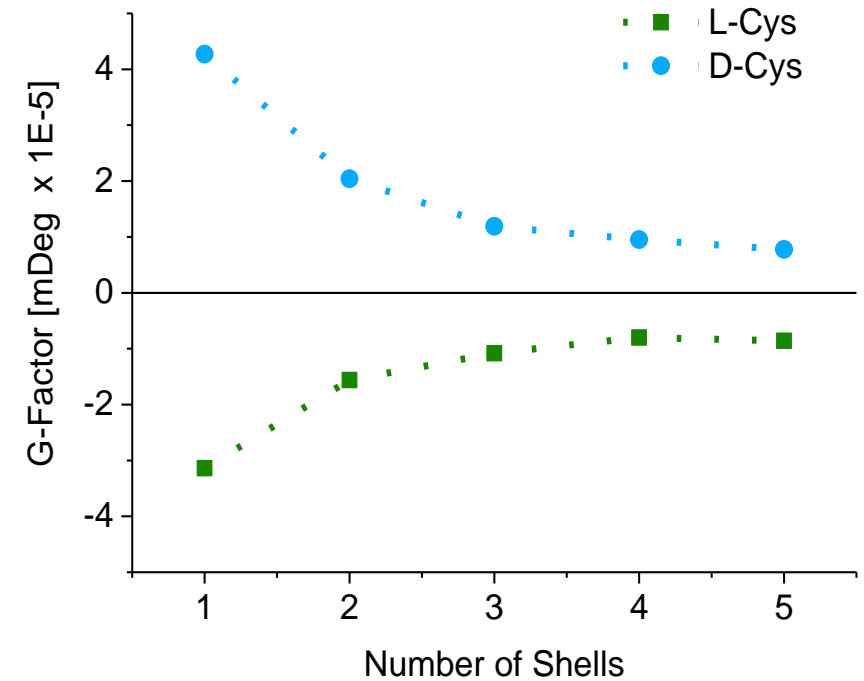
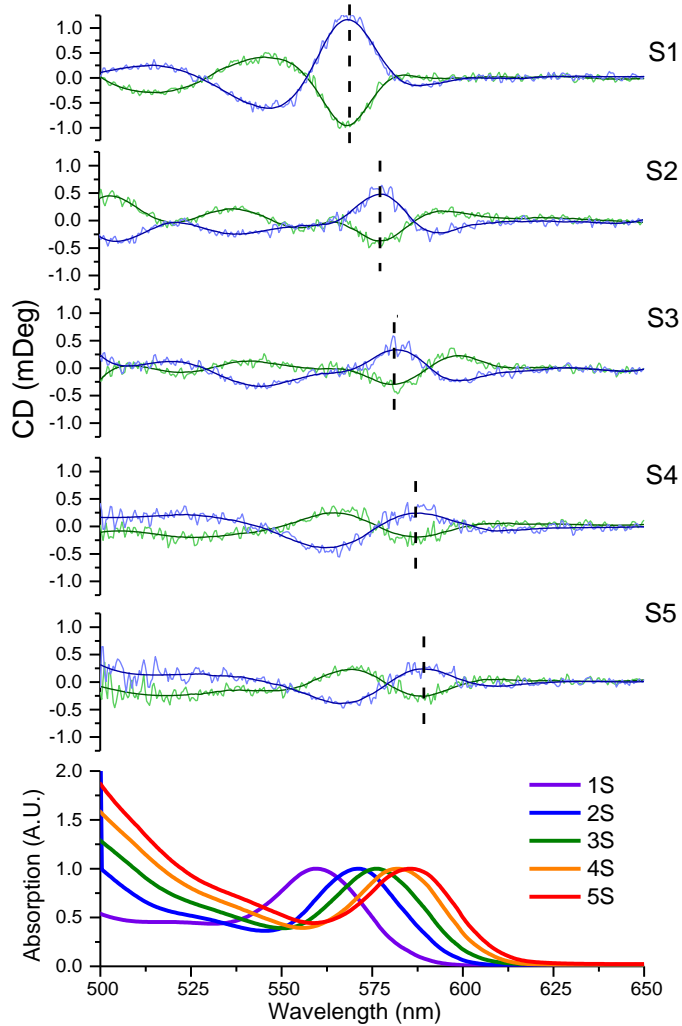
As-synthesized CdSe/CdS QDs were stabilized with achiral TOPO (trioctylphosphine oxide) molecules



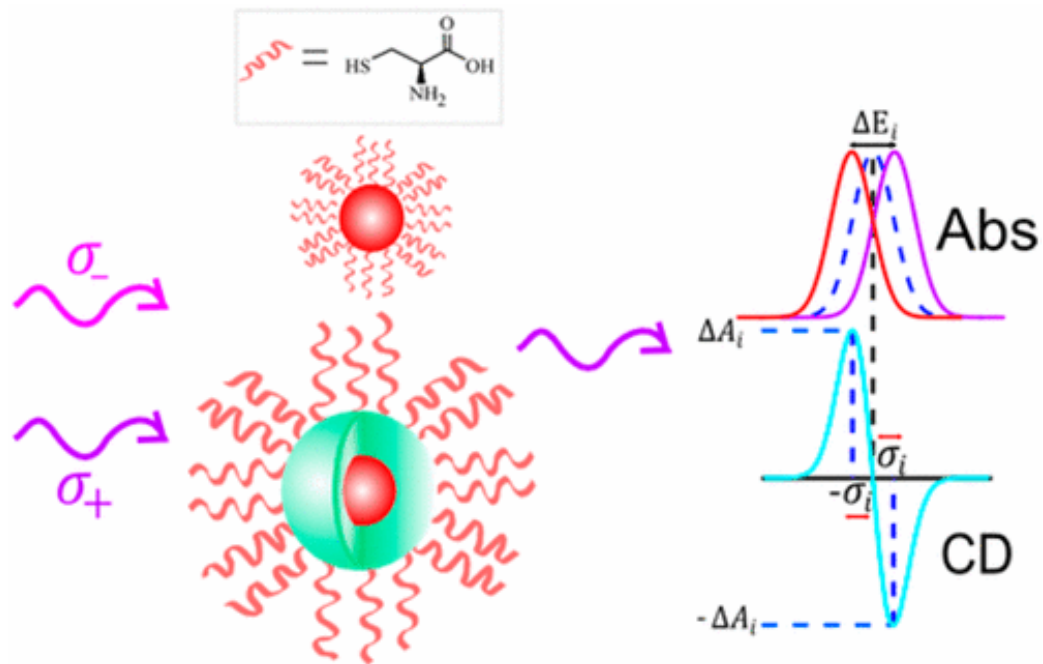
1. OPTICAL PROPERTIES OF QDs IN HYNSS



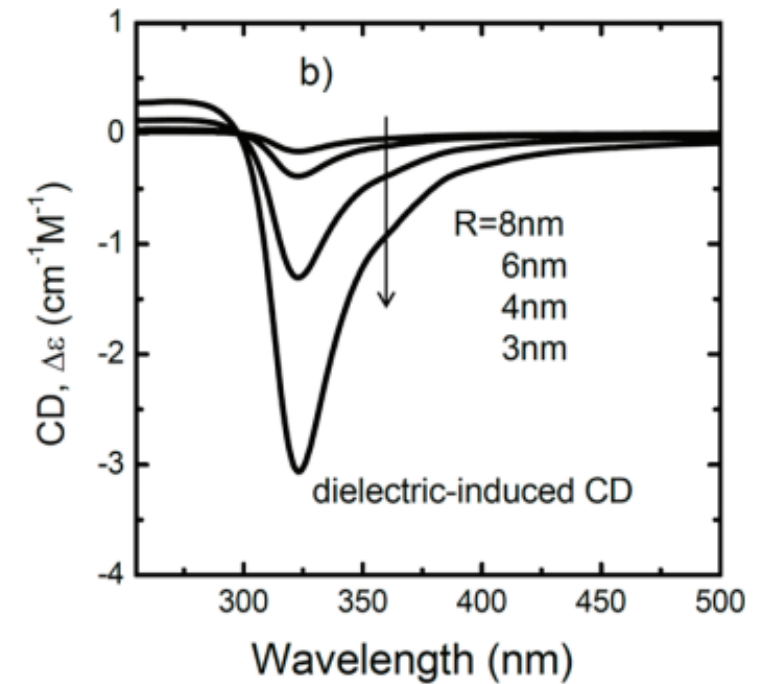
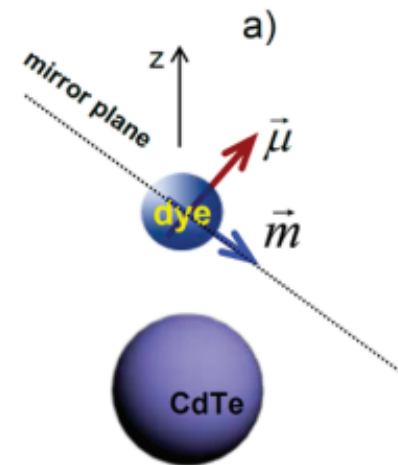
1. OPTICAL PROPERTIES OF QDs IN HYNSs



SEMICONDUCTOR QD + ORGANIC MOLECULE



Ben-Moshe et.al. Nano letters, 16 (12), 7467-7473, 2016

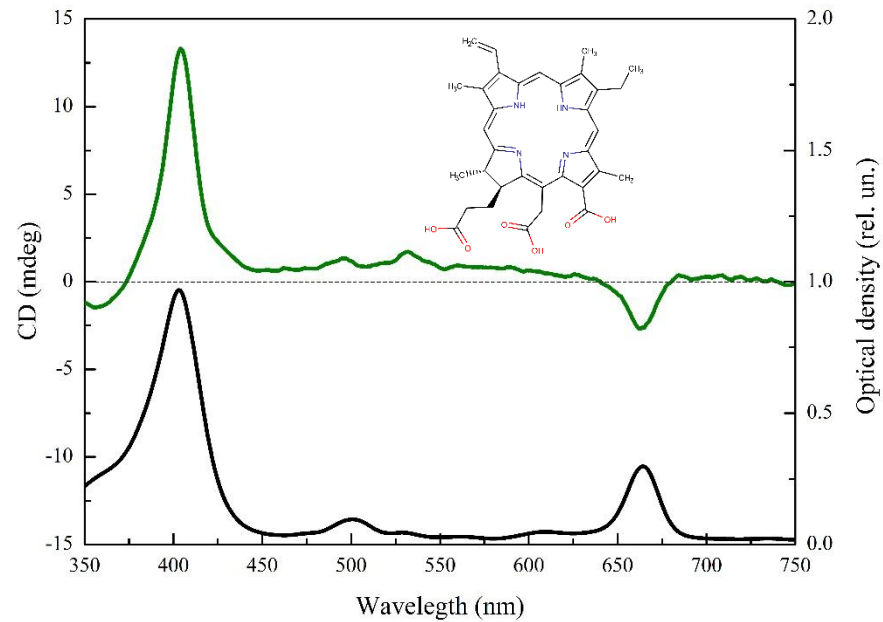


Govorov A.O., et al. Nano letters 10.4 (2010): 1374-1382

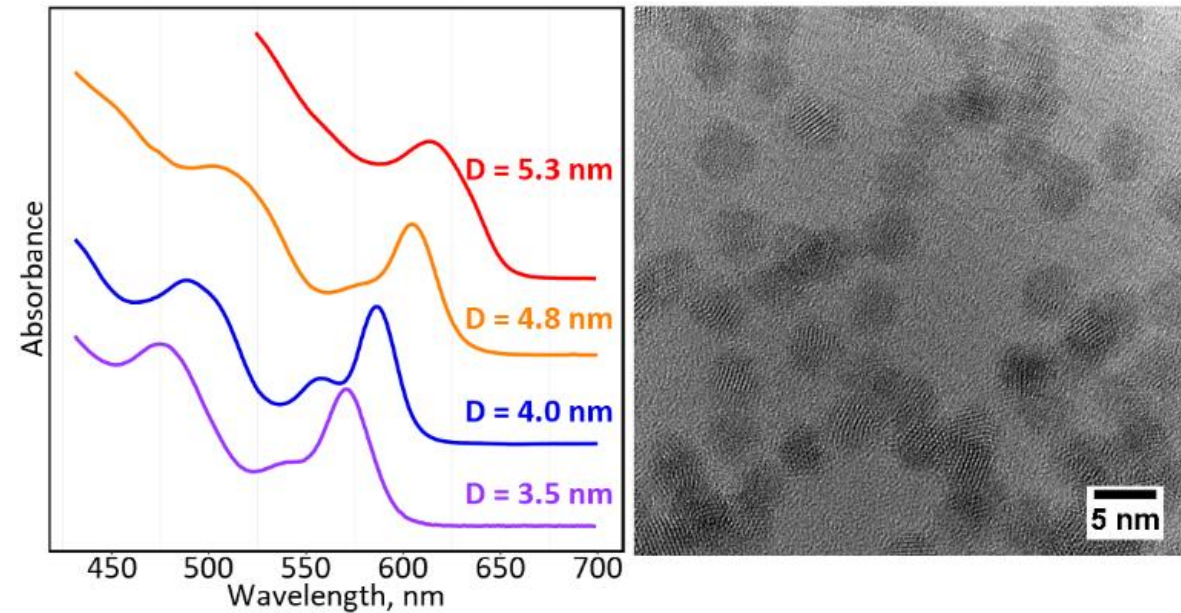
2. OPTICAL PROPERTIES OF CHIRAL MOLECULE IN HYNSS



Chiral molecule
Chlorin e6 (Ce6)

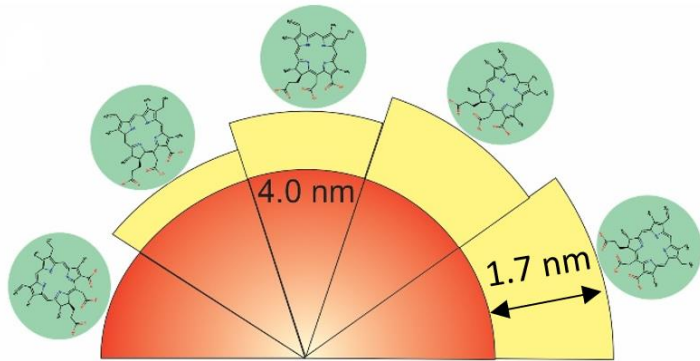


Achiral QDs (CdSe)

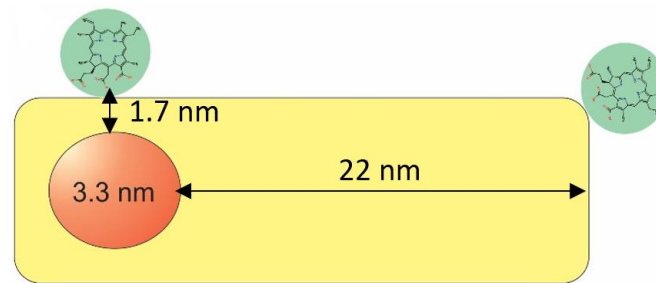





2. OPTICAL PROPERTIES OF CHIRAL MOLECULE IN HYNSSs

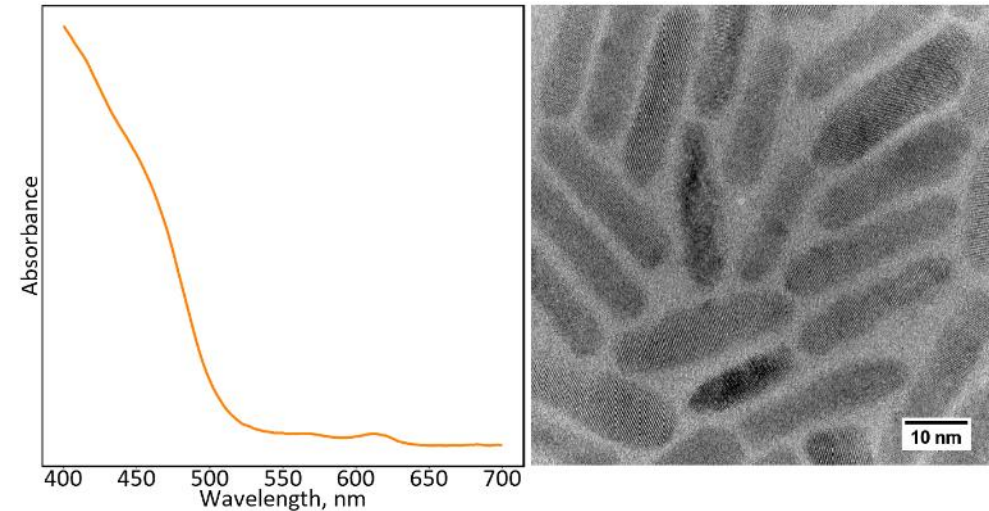
Achiral CdSe/CdS QDs

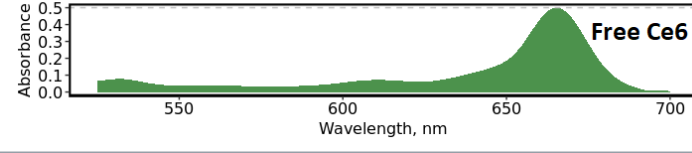
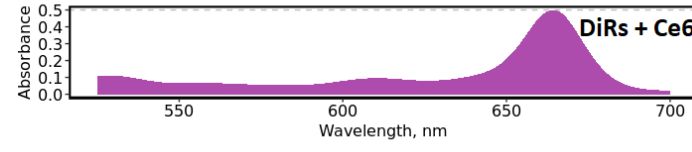
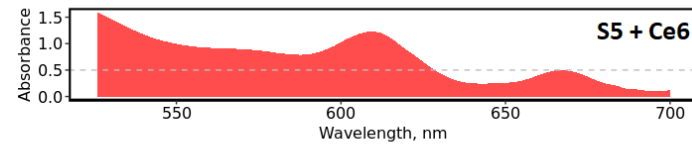
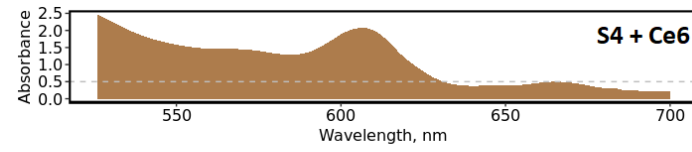
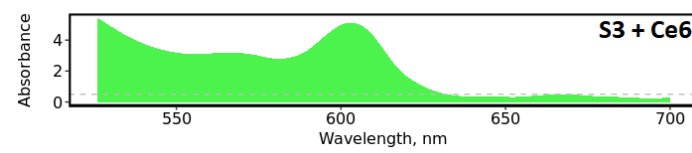
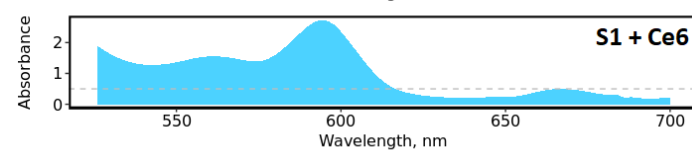
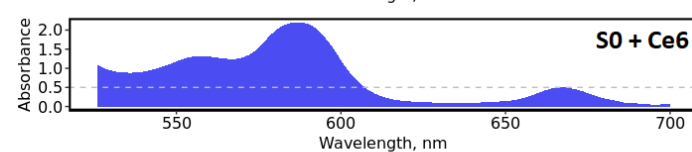
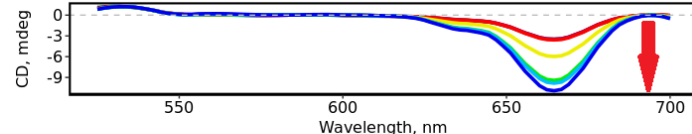
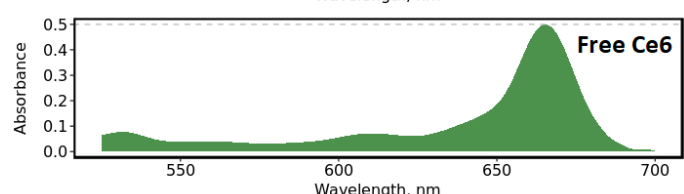
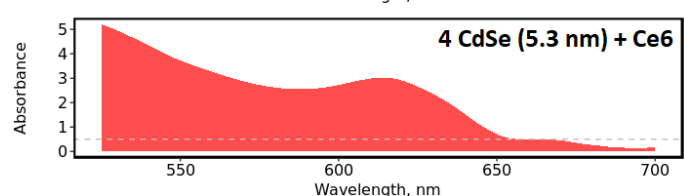
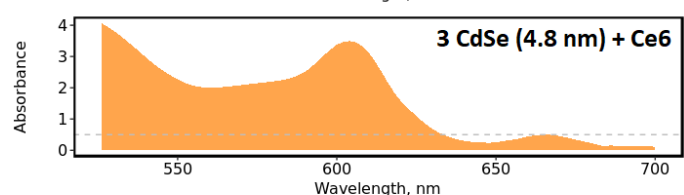
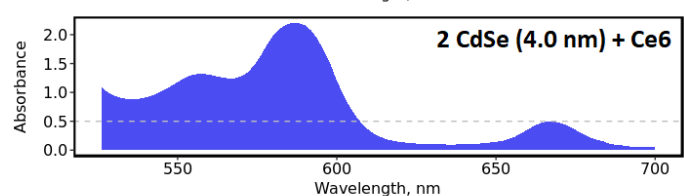
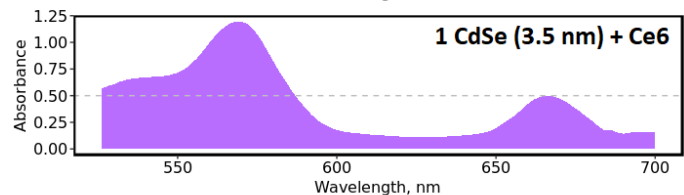
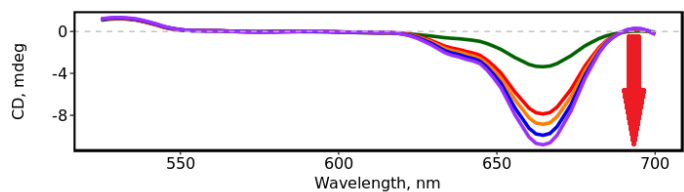


Achiral CdSe/CdS Dot-in-Rods



-  Chlorin e6 (Ce6)
-  CdSe
-  CdS



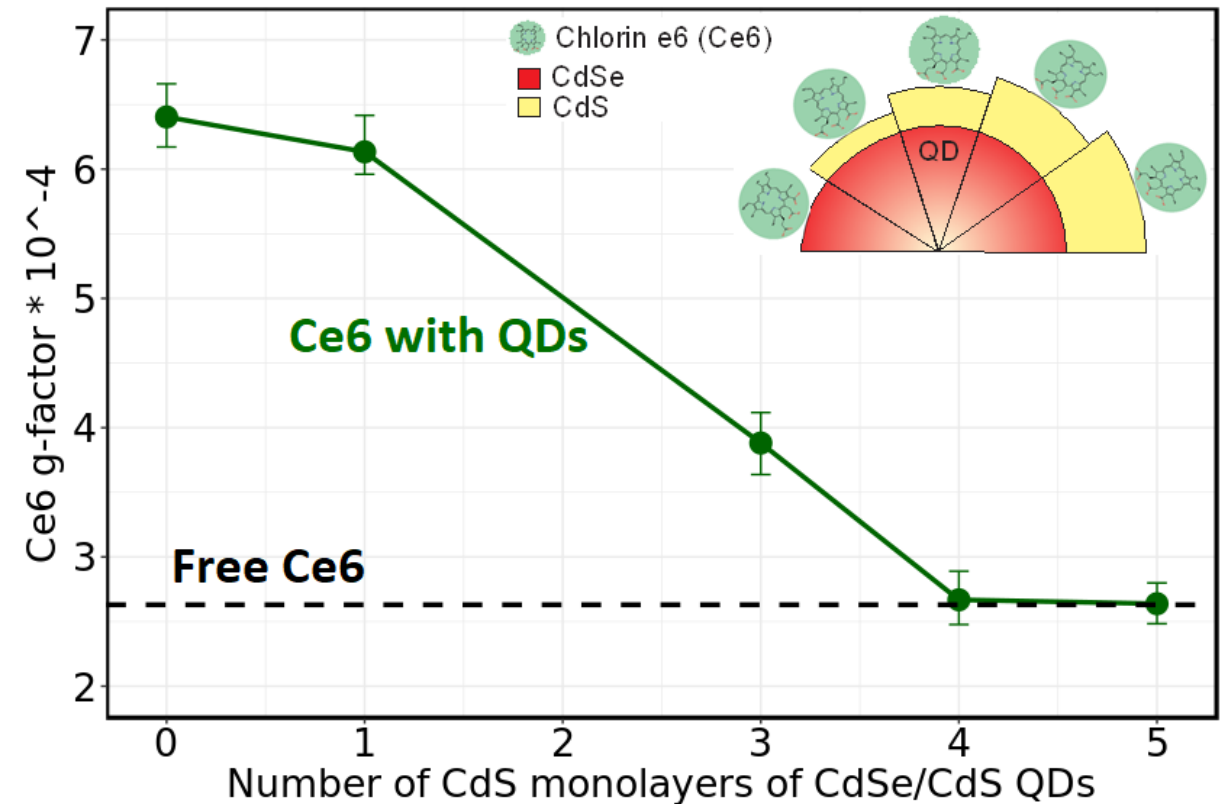
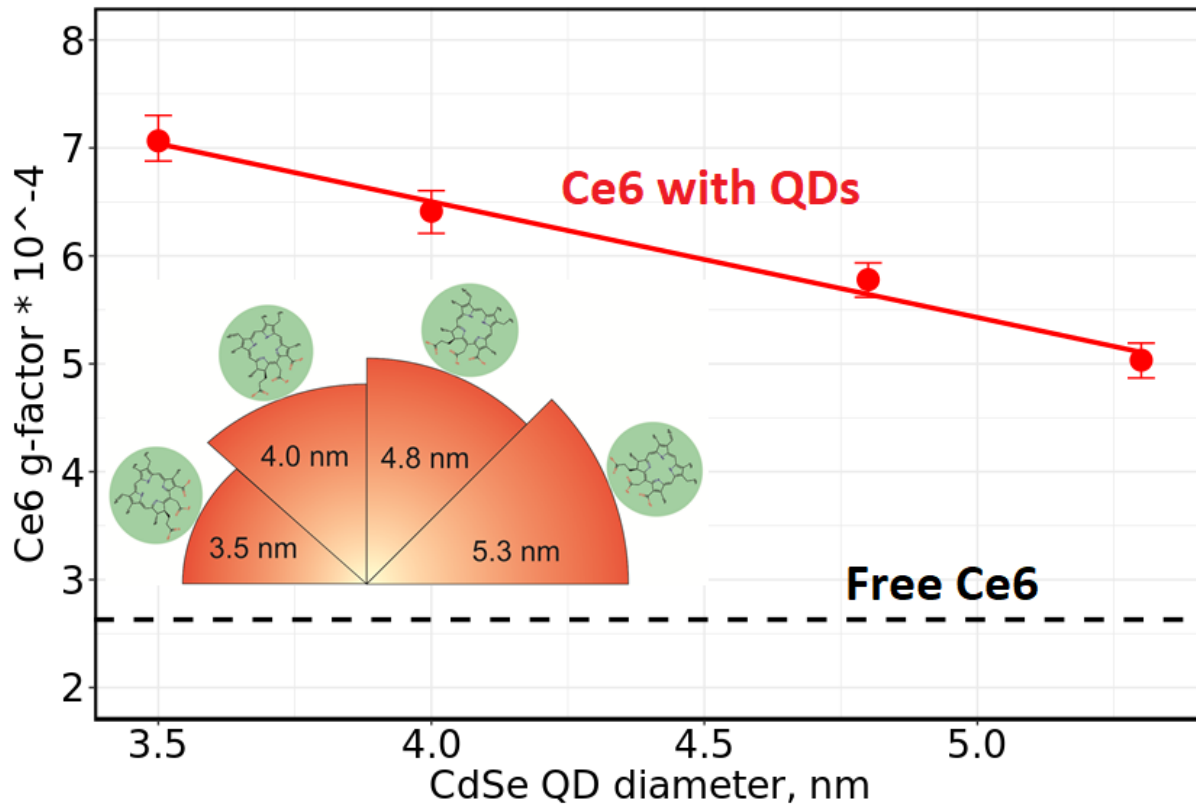


2. OPTICAL PROPERTIES OF CHIRAL MOLECULE IN HYNSS

QDs of different diameter

QDs of different shell thickness

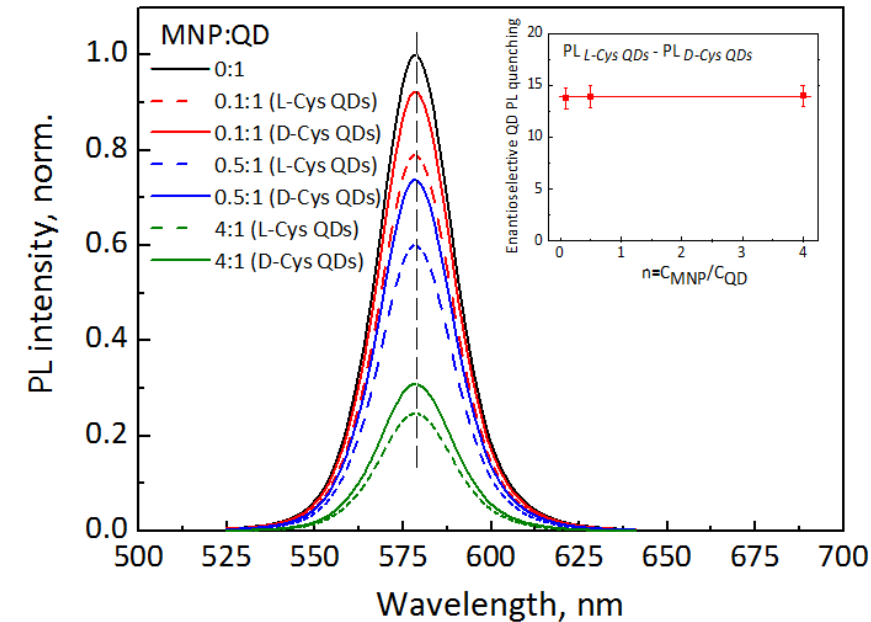
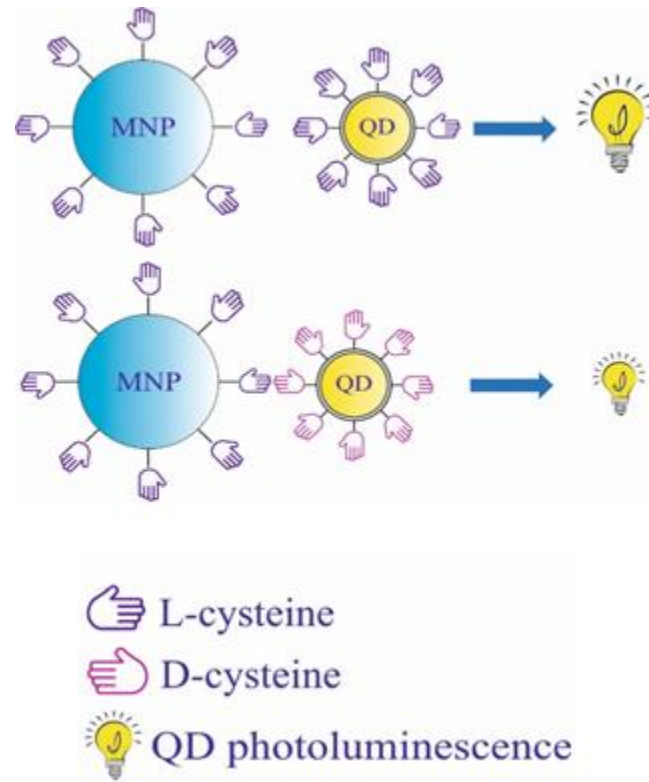
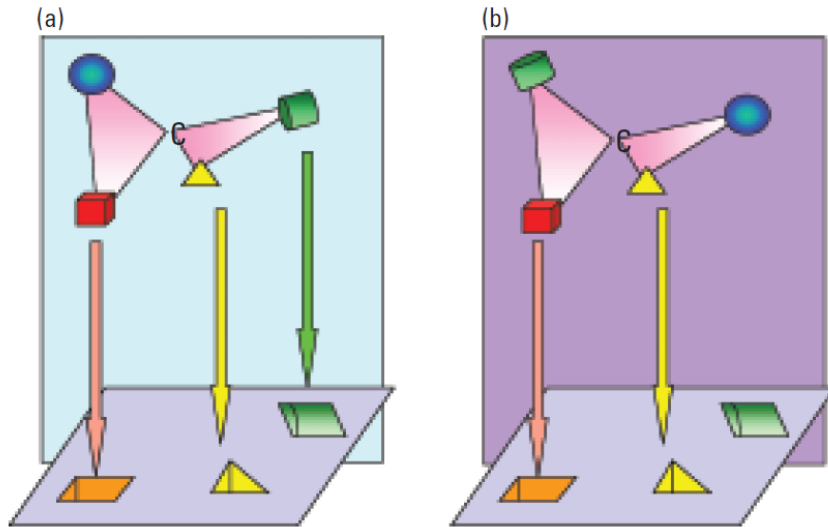
2. OPTICAL PROPERTIES OF CHIRAL MOLECULE IN HYNSS



3. INTERACTION OF CHIRAL HYNSs WITH SURROUNDING ENVIRONMENT

Chiral sensing and separation

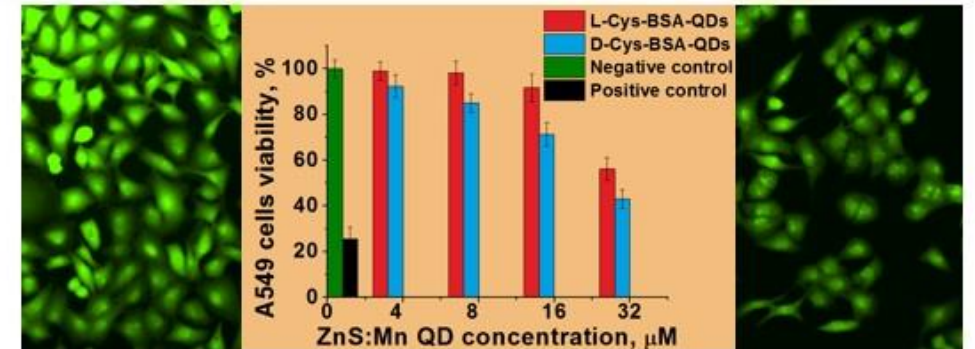
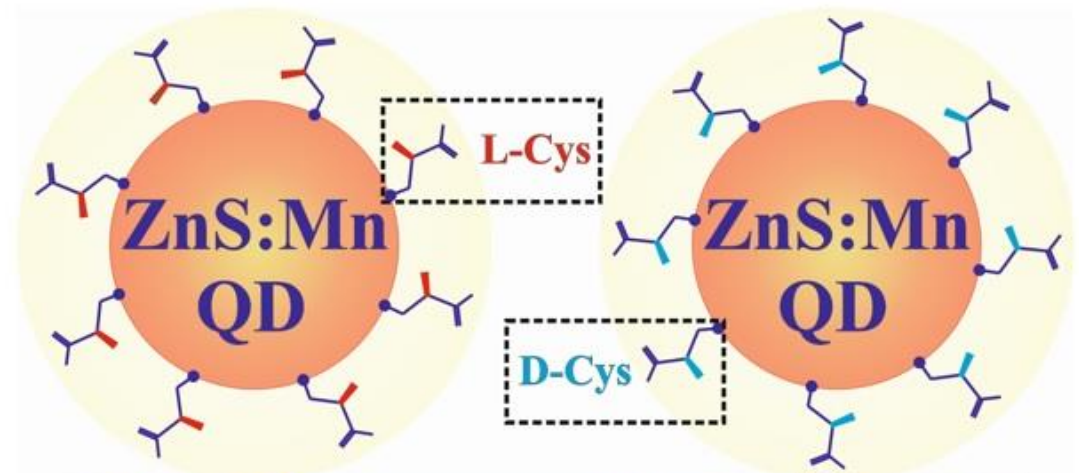
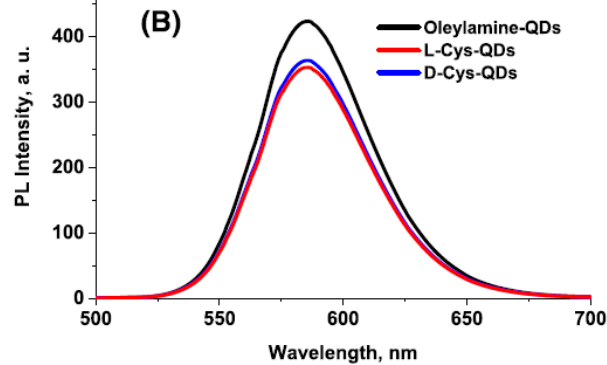
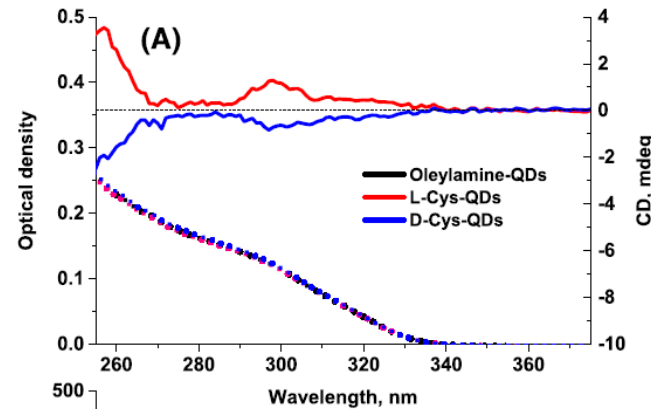
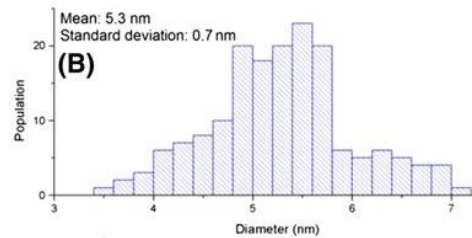
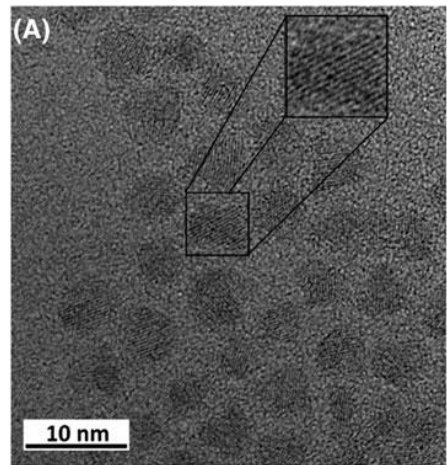
The three-point attachment model



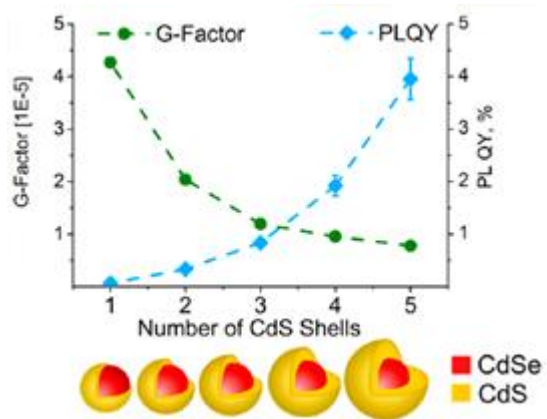
Berthod, A. (2006). Chiral recognition mechanisms

3. INTERACTION OF CHIRAL HYNSs WITH SURROUNDING ENVIRONMENT

Bioimaging

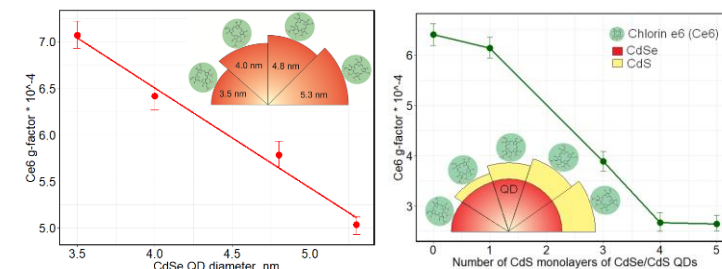


CONCLUSIONS AND ONGOING RESEARCH



1. Influence of QDs shell thickness on QD photoluminescent and chiral properties

2. Influence of semiconductor QDs on optical activity of chiral molecule



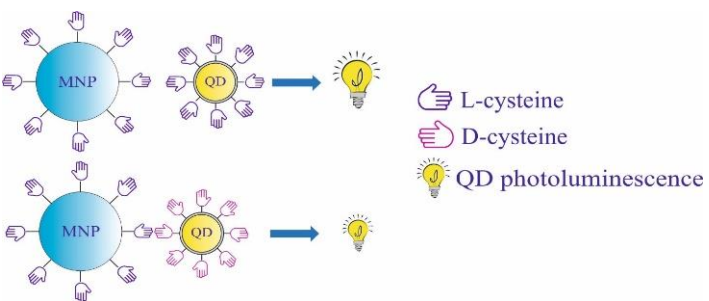
J. Mater. Chem. C, 2018, 6(7), 1759-1766

Ongoing research

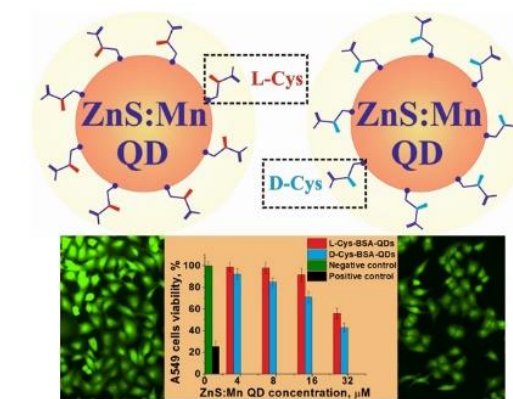
Investigate correlation between chiral and functional properties of hybrid nanostructures

3. Enantioselective interaction of chiral magnetic nanoparticles and chiral QDs

4. Enantioselective cytotoxicity of chiral QDs



J. Mater. Chem. C, 5(7), 2017, 1692-1698

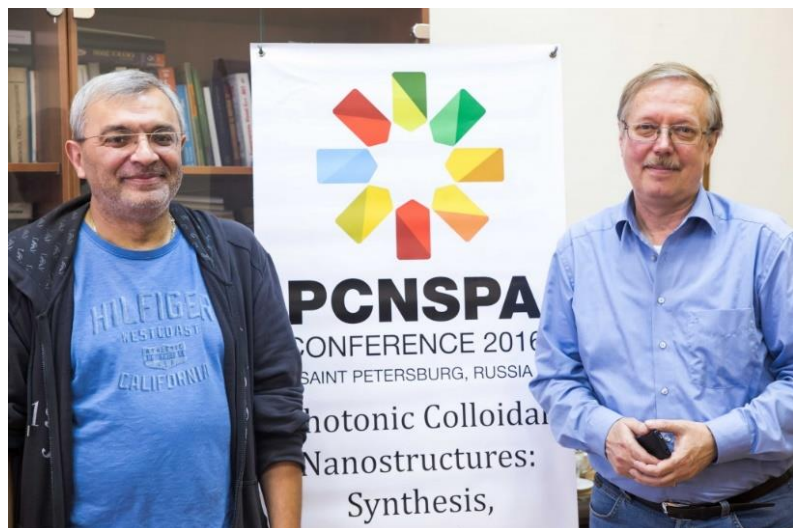


Chirality, 29(8), 2017, 403-408 18



Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Thank you for your attention!



**Ms. Kuznetsova Vera
Dr. Purcell-Milton Finn
Prof. Orlova Anna
Prof. Fedorov Anatoly
Prof. Baranov Alexander
Prof. Gun'ko Yurii**

