Investigation of CdSe Quantum Dot Quenching by Interaction with TNT

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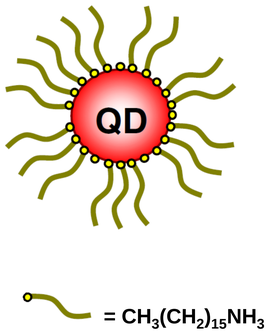
Abstract

Research is currently being conducted to observe the interaction between trinitrotoluene (TNT) and core-type cadmium selenide quantum dots (CdSe QDs) using fluorescence spectroscopy measurements. QDs are spherical nanoparticles which are only fluorescent in a small diameter range, on the order of nanometers. Through thorough titration methods and necessary data corrections, Stern-Volmer quenching plots can be derived. TNT appears to interact differently with CdSe QDs of different sizes, although the mechanism is not readily apparent.

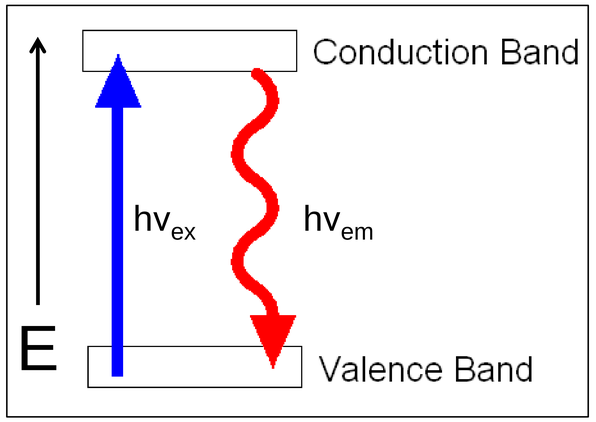
Relevance

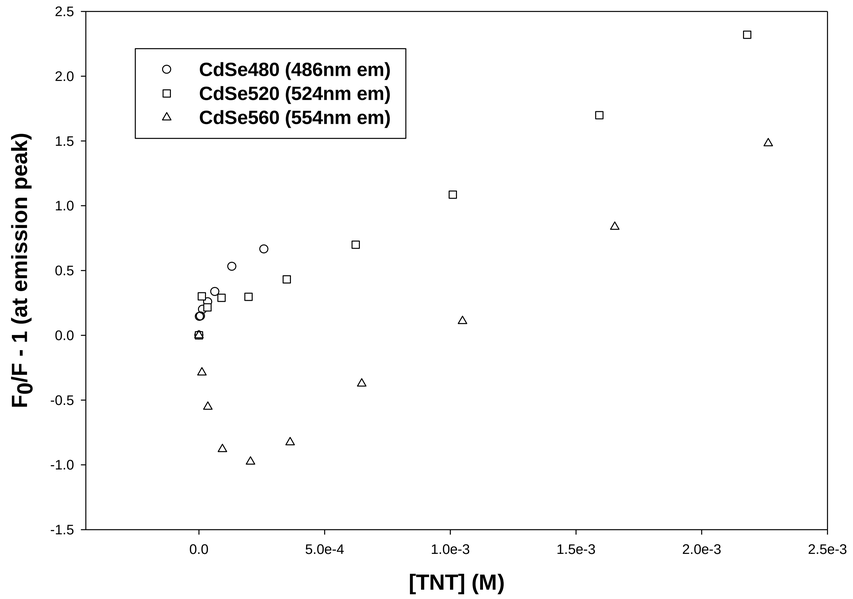
- Fluorescence of semiconducting quantum dots related to quantum confinement
  - Diameters on the order of 1nm
  - Tunable emission wavelength
  - Narrow spectral bandwidth
- Advantages over organic fluorophores:
  - Greater resistance to photobleaching
- Core/shell type quantum dots – increasing usage in sensory applications
  - Limited use/investigation of core type QDs
- Much research done related to TNT affinity to QD bound ligands, but little investigation into core-type QDs with alkyl ligand functionalities

Technical Approach



Jablonski Diagram for QD





Data has been corrected for primary and secondary inner filter effects and for photo-oxidative losses.

- No observed emission wavelength shift as seen by Nieto et al., implies different type of interaction than that of TNT with CdSe/ZnS QDs

Accomplishments Through Current Year

We have observed a size effect of the CdSe QD in titration with TNT. Although the mechanism is not currently understood, this effect may be able to be used as a selectivity parameter in an explosive sensor. This trend may continue with other CdSe QDs with varying diameter to yield further characteristic interaction for the differentiation of explosive analytes.

Future Work

- Titrations involving other CdSe QDs with varying diameter
- Titrations involving other molecules in the nitrotoluene family and other relevant explosive molecules

Opportunities for Transition to Customer

Given a different Stern-Volmer profile for CdSe QDs exposed to other relevant explosive analytes, this system may serve as a selectivity parameter in an explosive sensor.

Patent Submissions

Publications Acknowledging DHS Support

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Other References

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