Photoluminescence and Photobleaching Studies of Colloidal CdSe Quantum Dots

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Background/Relevance

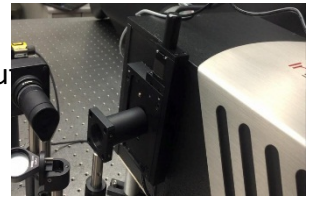
- CdSe colloidal Quantum Dots (QDs) exhibit photoluminescence due to their direct band gap structure, and are desirable for applications in both medicine and industry.
- In photoluminescence, an incident photon excites an electron, and a photon with energy equal to the band gap energy is released spontaneously upon relaxation.
- Photobleaching is the drop in intensity of QD emission due to prolonged exposure to laser radiation.

Innovation

- Characterize the effect of varied incident laser powers on photobleaching, emission blueshifting, and mean lifetimes of QDS.

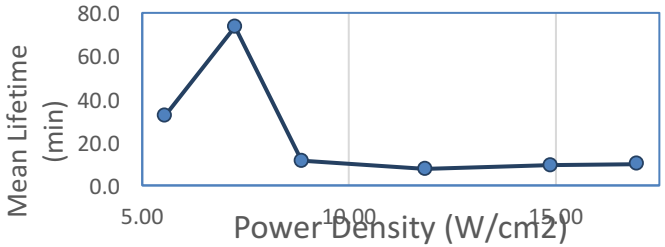
Approach

- Prepare QD samples by dropcasting QDs onto Wafer .
- Mount Sample into the Herzog lab's custom microscope objective.
- Use CMOS camera to isolate individual QDs by looking for blinking (flickering of emitted light).
- Vary 532 nm, 5mW laser's power using step attenuator.
- Use spectrometer to take 3 spectra per minu for 15 minutes.
- Repeat for 5 QDs per laser power density.



Key Results

- Using photobleaching data, determined that above 8 W/cm^2 incident laser power densities, QDs are bleached at around 10 minutes.
- Lifetime is at a maximum at 7.24 W/cm^2
- QDs are bleached faster and more severely at higher power densities.
- QDs blueshift more prominently under higher power densities.



Conclusions

- To avoid or mitigate photobleaching, use power densities less than 8 W/cm^2
- Maximum lifetime coincides with the laser power density where 33.33% of QDs brightened over 15 minutes instead of bleaching.
- QDs bleach and blueshift faster and more severely under higher power densities.

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