Band Offset Determination in CdSe Nanocrystals by Novel Optical Techniques

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Band offset measurements

The band offsets of CdSe and PbSe nanocrystals are critical to solar cell design.

CdSe energy levels:

1. Bulk CdSe
2. 38.5 Å nanocrystals
3. 29.3 Å nanocrystals
4. 20.6 Å nanocrystals

Band Offset Measurement Approaches

FELIPE: Free-Electron Laser Internal PhotoEmission

Measure created photocurrent versus wavelength

SHG: Second-Harmonic Generation

Detect Electric-Field Induced Second Harmonic (EFISH) signal at varying wavelengths

Observation of threshold!
Feasibility experiment…

SHG signal:

- Minimal contribution from Si (centrosymmetric) and CdSe nanocrystals (random orientation).
- Any time-dependence can be attributed to charge separation due to carrier injection.
Preliminary SHG Data on Si/CdSe

- TIME DEPENDENCE!!! (electron or hole injection?)
- The SHG signal is dependent on beam intensity and film thickness.
Conclusion

Both SHG and FELIPE are useful tools for band offset measurements.

• very wide wavelength range available => guaranties a successful result

• time-dependent SHG experiments can be used to gain dynamical information (electron-hole recombination times and carrier trapping times)

• successful preliminary studies on Si/CdSe system