Transformations of Biologically-Conjugated CdSe Quantum Dots Released into Water and Biofilms

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Quantum Dots

- 3 to 7 nm (bare CdSe)
- used in biological labeling
- wide absorbance, narrow emission spectra

Absorbance

Emission

Triple-labeled *S. aureus*
Quantum Dots (cont.)

A. bare

B. core shell

C. conjugated
Project Goals

- Determine fates of CdSe QDs under abiotic and biotic conditions
- Determine toxicity of QDs to bacteria
- Determine damage of QDs to DNA
- Determine how QD coating or conjugation alters effects
- Compare effects of dissolved Cd and Se
Research Objectives (1/2)

- Quantify QD breakdown in aqueous solutions
  - pH, reducing conditions, light, oxygen
  - bare, core-shell, conjugated QDs

- Quantify microbial uptake and breakdown
  - liquid culture, *S. aureus*, *P. aeruginosa*
  - growth effects, QD fates, breakdown products
Investigate DNA damage
- oxidation of isolated G and A by TCSPC
- oxidation of G in DNA; quantify oxidation product

Investigate effects on and of bacterial biofilms
- saturated and unsaturated
- growth effects, toxicity, & macromolecular interactions
- breakthrough in colonized porous media
Preliminary Data

- Acid quenches more than base (A)
- Reduction-mediated partial quenching (B)
- Light-mediated fluorescence enhancement (C)
**Preliminary Data (cont.)**

*B. subtilis aprt* mutants label brightly with CdSe-AMP QDs (light, pH 5)

QDs effectively stain cells for TEM imaging
- adenine quenches green (left) and red (right) QDs
- light restores
Project Plans

- 3 years, begin late 2004
- Initially establish protocols across labs
- Nadeau Lab
  - Aqueous fates
  - Liquid culture effects and fates
  - DNA oxidative damage
- Holden Lab
  - Biofilm studies
  - Column breakthrough characteristics
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