Using Fluorescence Spectroscopy to Determine Concentrations of Quantum Dot Solutions

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**Key Finding**

Emission spectroscopy can be used to characterize concentrations of QD solutions with inexpensive laboratory equipment.

**Introduction**

Quantum dots (QDs) are fluorescent nanoparticles. They are used as biomarkers and in display technology. Nanoparticle solution concentration has been characterized by expensive methods such as nanoparticle tracking analysis. We assessed the utility of using UV-Visual (UV-Vis) fluorescence spectroscopy, a cheaper and more widely available tool.

**Methods**

**Concepts**

- QDs in solution absorb light directly proportional to concentration
- QDs fluoresce at different colors, but the relationship to concentration is not established

**Tools**

- Thermo Fisher Genesys Spectrophotometer
- Horiba Fluoromax-3
- StellarNet EPP2000

**Results - Absorbance**

Beer’s Law

\[ \log_{10} \frac{I_0}{I} = \varepsilon lc = A \]

- \( I_0 \) – light intensity entering the sample [W/m²]
- \( I \) – light intensity leaving the sample [W/m²]
- \( \varepsilon \) – extinction coefficient [mL mg⁻¹ cm⁻¹]
- \( l \) – path length [cm]
- \( c \) – concentration [mg/mL]
- \( A \) – absorbance [unitless]

Genesys slope = 4.1 ± 0.1 (mg/mL)⁻¹

**Results - Fluorescence**

Fluorescence peak area values for two different spectrometers.

- Fluoromax slope = 106 ± 2 (mg/mL)⁻¹
- StellarNet slope = 88 ± 2 (mg/mL)⁻¹

**Future Work**

In mixed-color solutions, absorption spectra only provide readings at single wavelengths. Emission spectra yields two distinct color peaks allowing for color-specific concentration determination in mixed-color solutions.

Red and green QDs that can be mixed in future experiments

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