Silver indium sulfide quantum dots as long-wavelength photoinitiators and preparation of luminescent nanocomposites

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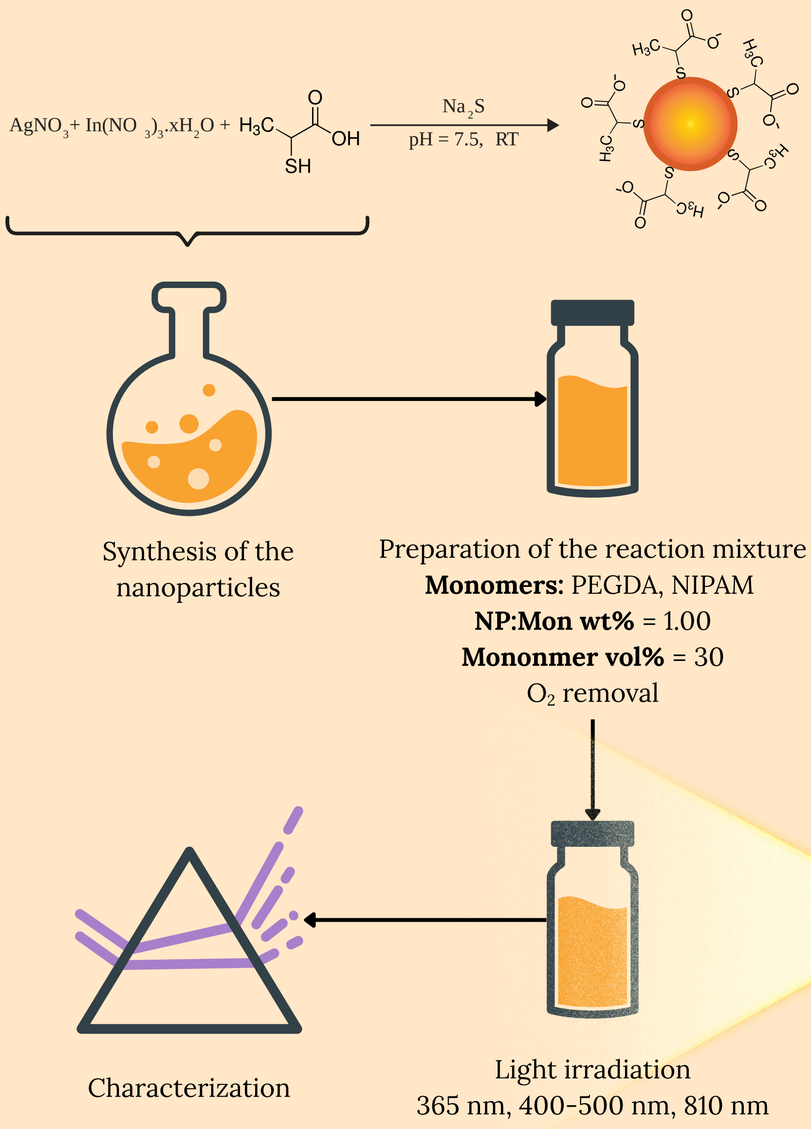
Background

Quantum dots are a class of nanomaterials prominent in imaging and therapy due to their ability to interact with light. Upon light illumination of various wavelengths, they can generate radicals that can be utilized to initiate free-radical polymerization. In this study, we explore anionic silver indium sulfide ($AgInS_2$) quantum dots as long-wavelength photoinitiators in aqueous media. We report, for the first time, the use of $AgInS_2$ quantum dots to initiate polymerization under various irradiation wavelengths, most significantly the near-infrared region.

Method



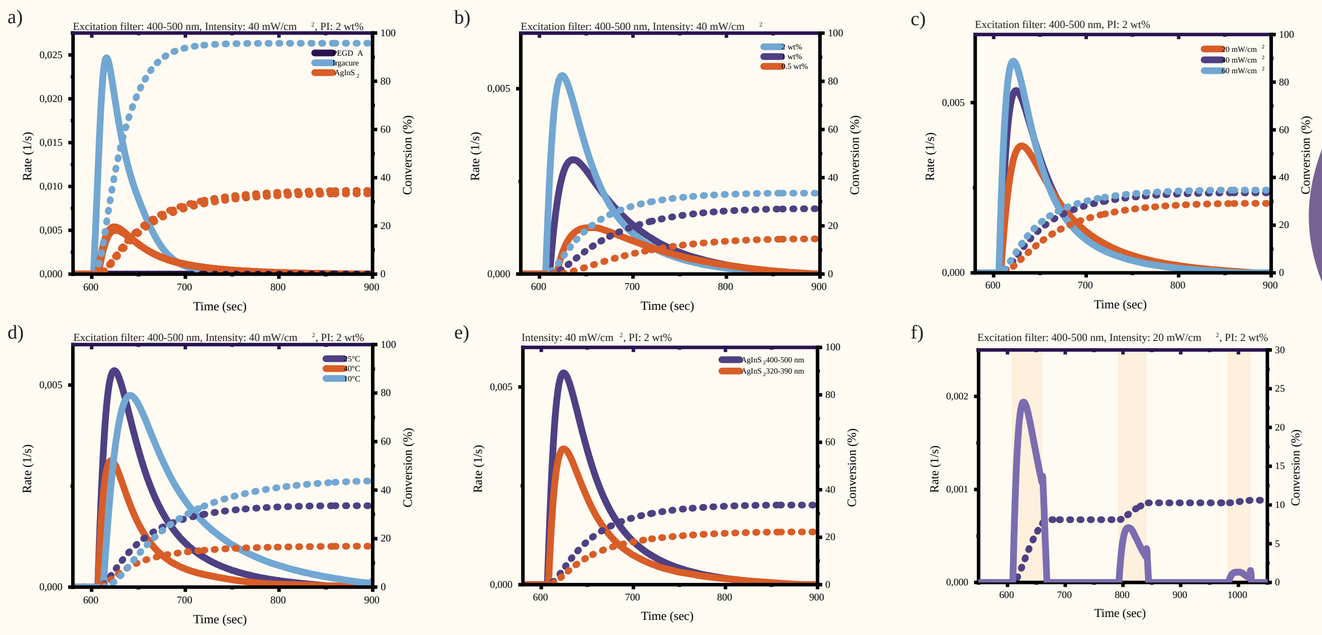
Key Points

- Environmentally friendly **aqueous** photopolymerization was achieved
- $AgInS_2$ quantum dots were utilized as **one-component** photoinitiators without the requirement for co-initiators or additives
- Due to broad absorbance spectra of QDs, **long-wavelength** photoinitiation was achieved demonstrated with 400-500 nm Photo-DSC studies and 640 nm (not shown) and 810 nm qualitative tests
- Quantum dots remained intact in the polymer network and contributed to the **luminescent composites**
- Quantum dot-polymer interaction resulted in **altered Lower Critical Solution Temperature (LCST)** of the poly(N-isopropylacrylamide)
- Polymer conversion increased with increased nanoparticle concentration, light intensity, and reduced temperature

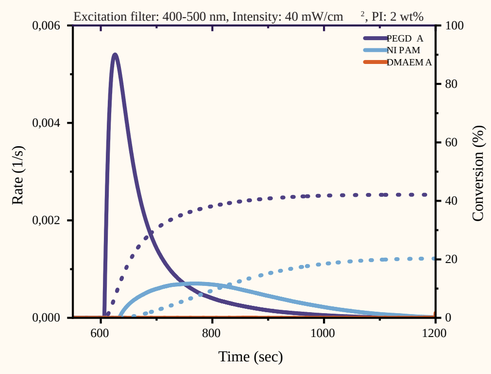
Results

1) Qualitative photopolymerization tests

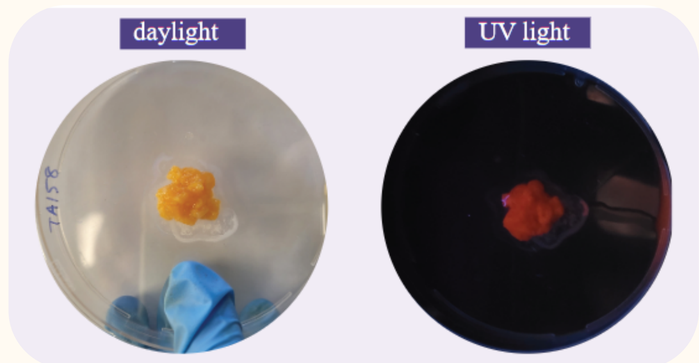
2) Kinetics studies of PEGDA with Photo-DSC



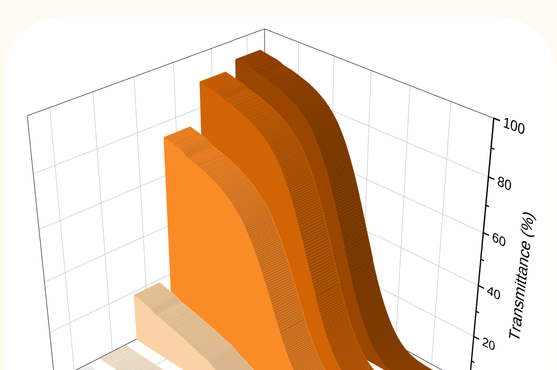
3) Comparing monomers

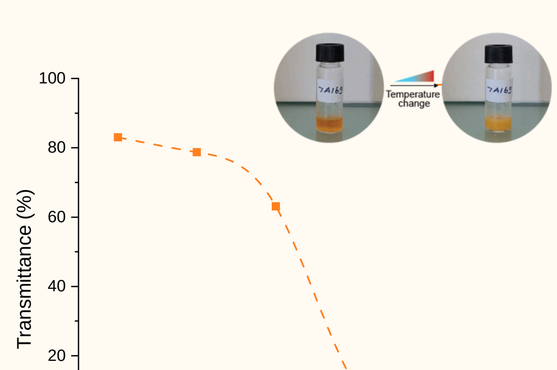


4) Luminescent composites



5) Adjusted Lower Critical Solution Temperature of PNIPAM





Future Perspectives

- Identification of the radical type(s) that initiate the photopolymerization
- Investigation of the mechanisms underlying a unique photopolymerization phenomenon observed at 810 nm
- Altered material properties of the luminescent composites

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