



Photodegradable Crosslinked Nanogels

Amanda Mc Kee,* Ali Sulehria,* Ryan Grant, and Dr. Lisa Kelly
Department of Chemistry and Biochemistry, University of Maryland, Baltimore County

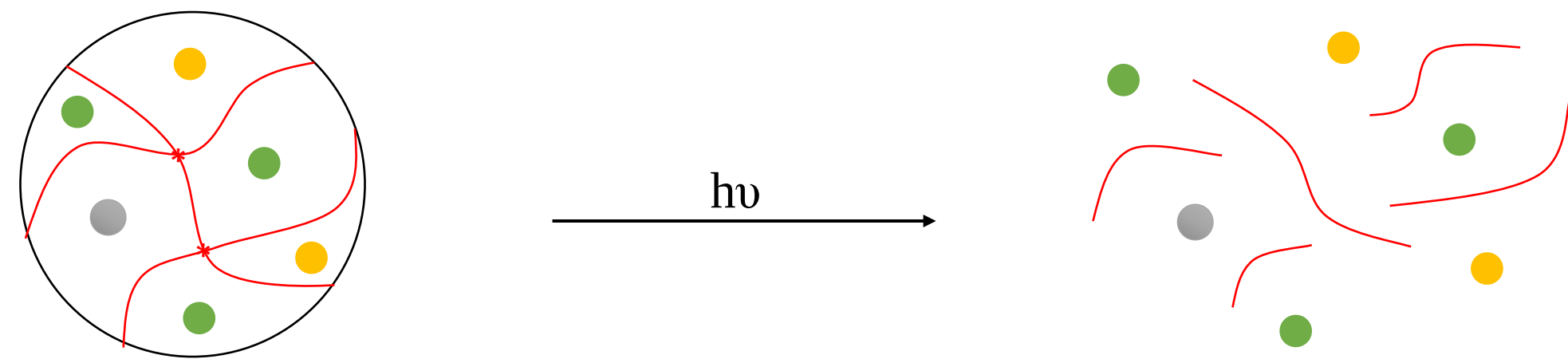


Abstract

The synthesis, characterization, and incorporation of a photocleavable crosslinker into nanogels is reported. 1,6-diisocyanohexane (**1**) was synthesized and confirmed using ^1H NMR and FTIR. PCDA (**2**) was synthesized using a Passerini reaction and the structure was confirmed using ^1H NMR and FTIR. Photocleavage using 365-nm light of 2-nitrobenzyl alcohol was monitored by UV-vis spectroscopy. Nanogels were synthesized from both non-photolabile and photolabile crosslinkers and had a diameter of 280.3 nm and 283.0 nm respectively. Photodegradation of the nanogels was observed using UV-vis spectroscopy and dynamic light scattering (DLS).

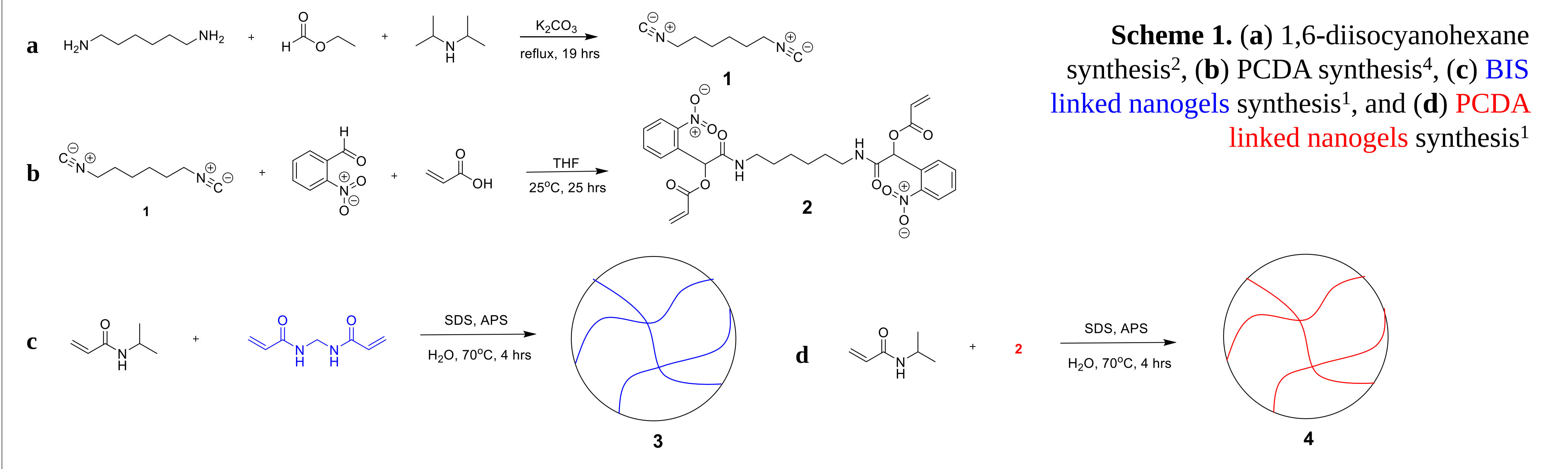
Significance

- Nanogels are crosslinked polymers that absorb other molecules.
- A photolabile crosslinker allows for the nanogel to be broken down with exposure to UV light.
- Photosensitive crosslinkers generally require long, complex syntheses.
 - One-pot Passerini reaction is a simpler and more efficient synthesis.
- The dual responsiveness of the PCDA nanogels makes them a powerful tool for a variety of applications, especially those where controlled or targeted release is essential, like drug delivery and water treatment.
- Lower critical solution temperature (LCST) is the temperature the nanogels collapse and expel water.



PCDA Linked Nanogels

Reactions



Scheme 1. (a) 1,6-diisocyanohexane synthesis², (b) PCDA synthesis⁴, (c) **BIS linked nanogels** synthesis¹, and (d) **PCDA linked nanogels** synthesis¹

^1H NMR of PCDA

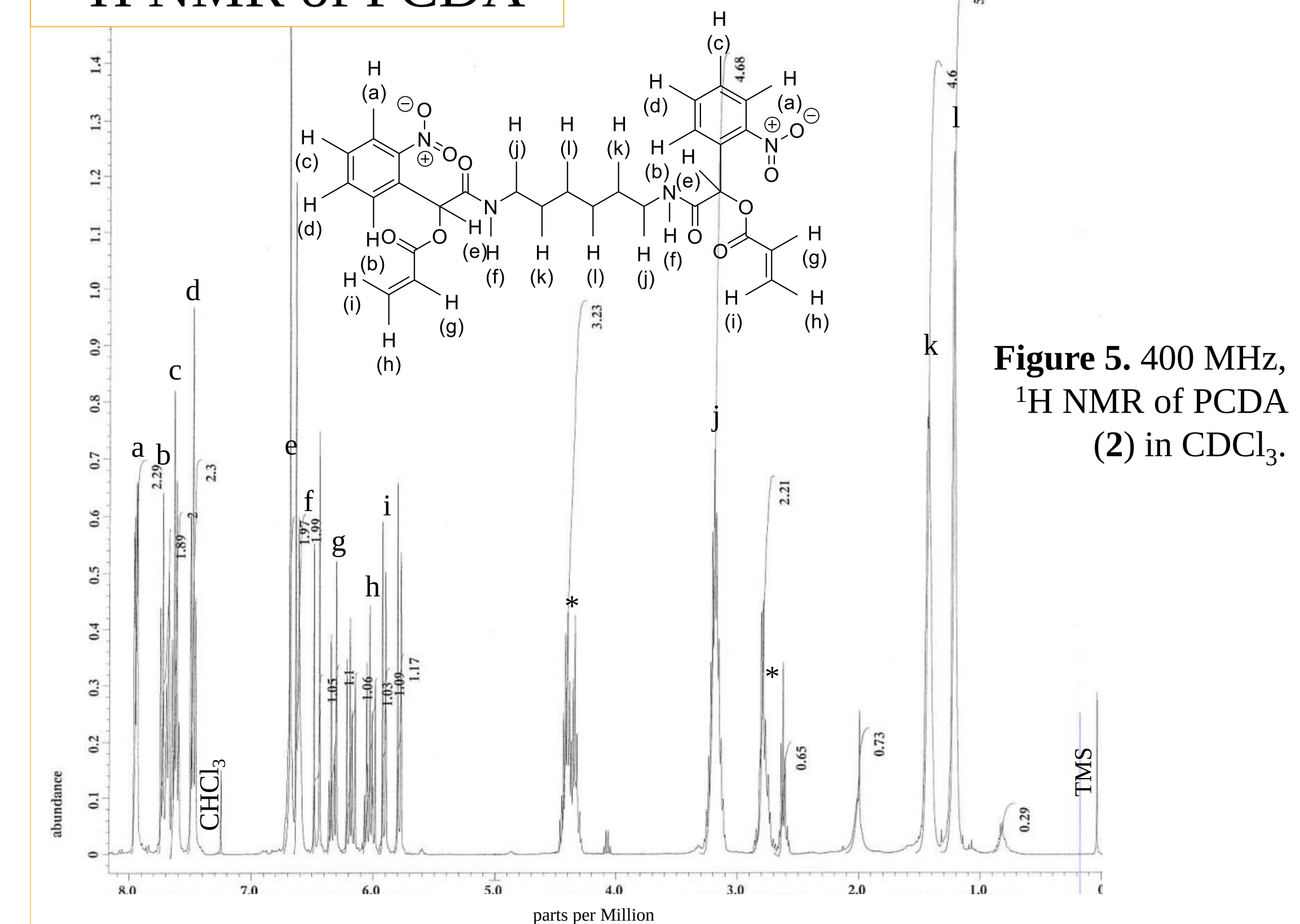


Figure 5. 400 MHz, ^1H NMR of PCDA (**2**) in CDCl_3 .

PCDA

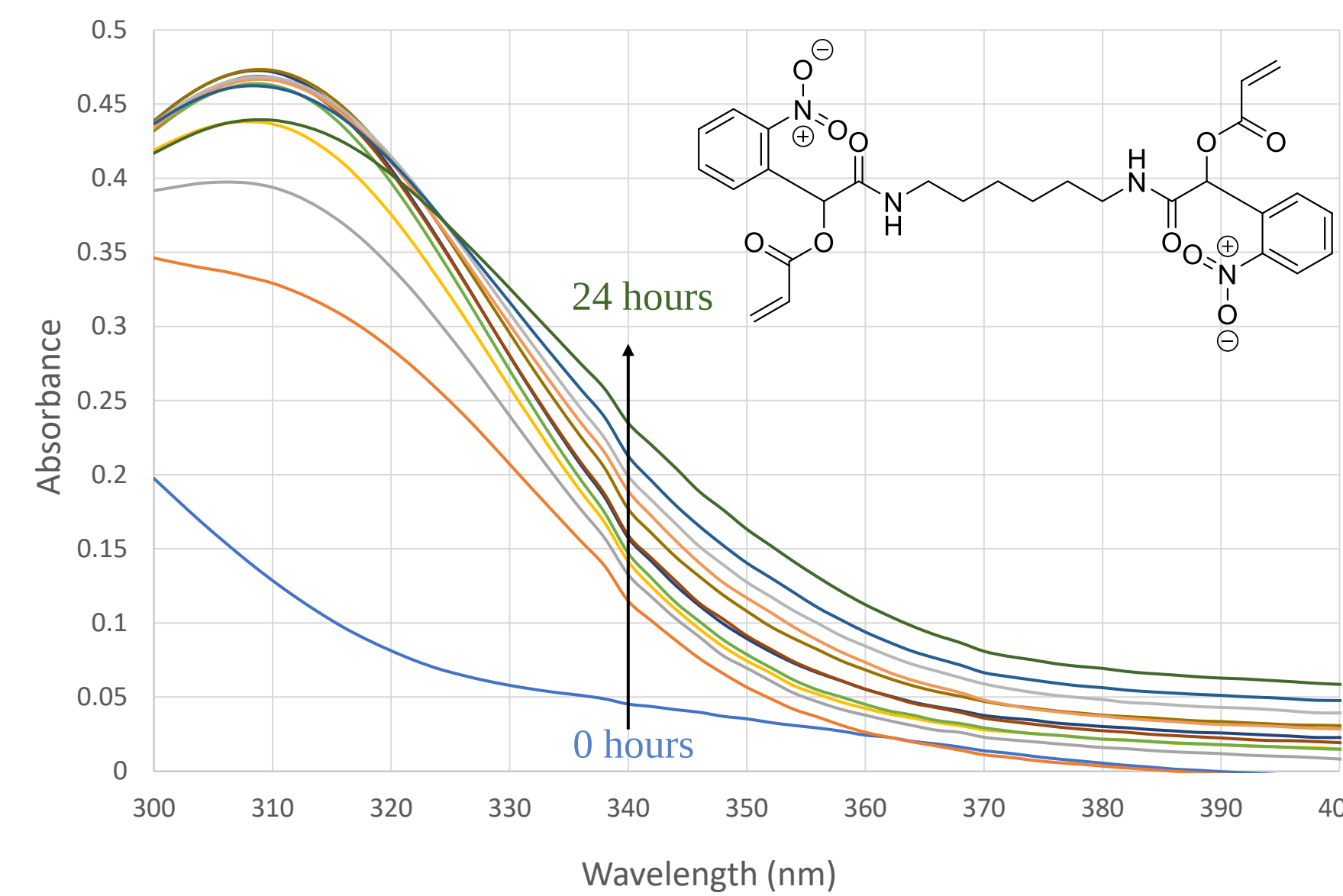


Figure 1. 1.1×10^{-4} M PCDA in THF was irradiated at 356-nm from 0 hours to 24 hours and monitored by UV-vis.⁵

UV-vis

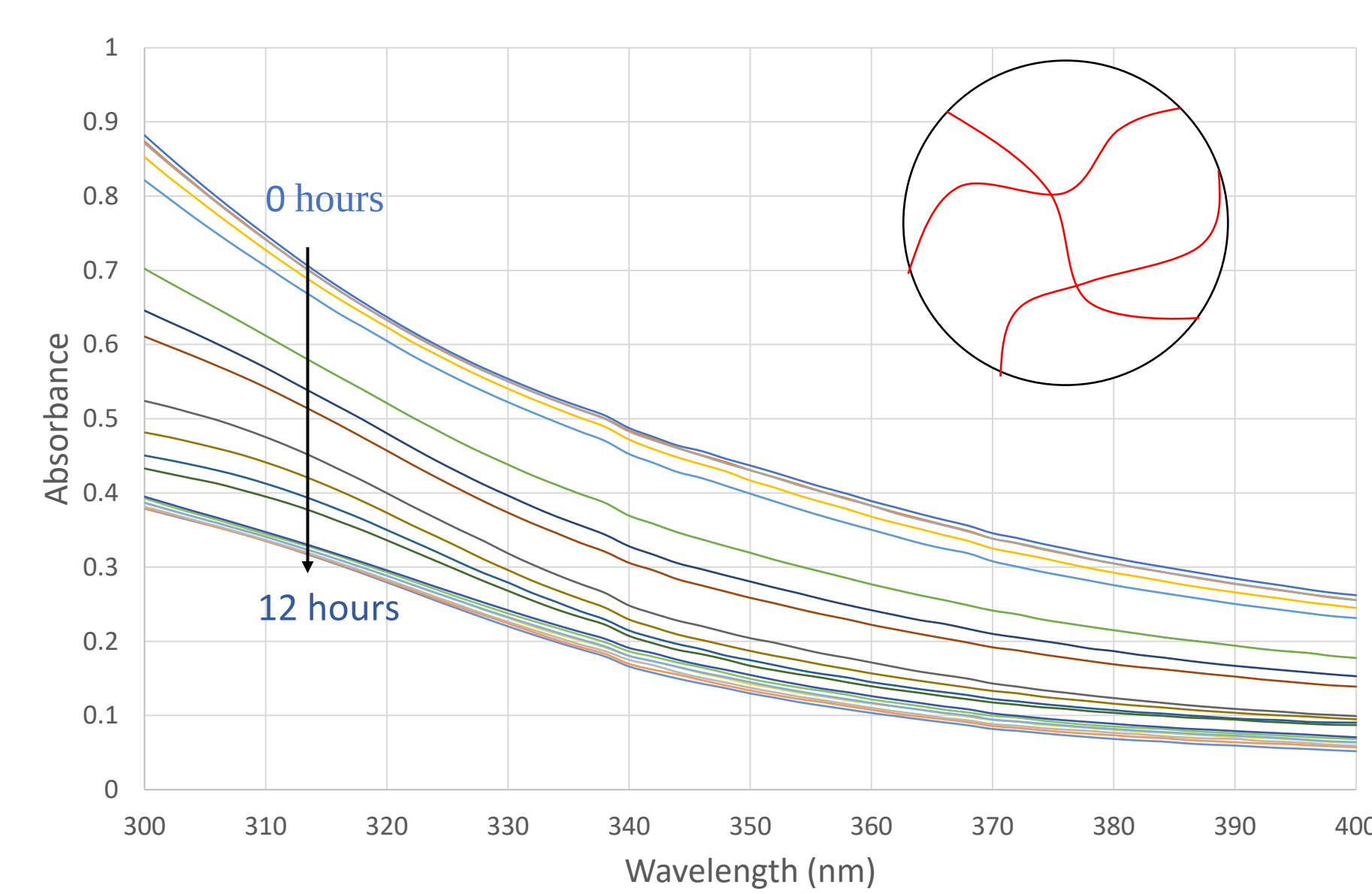


Figure 2. **PCDA linked nanogels** in H_2O was irradiated at 365-nm from 0 hours to 12 hours and monitored by UV-vis.

PCDA Linked Nanogels

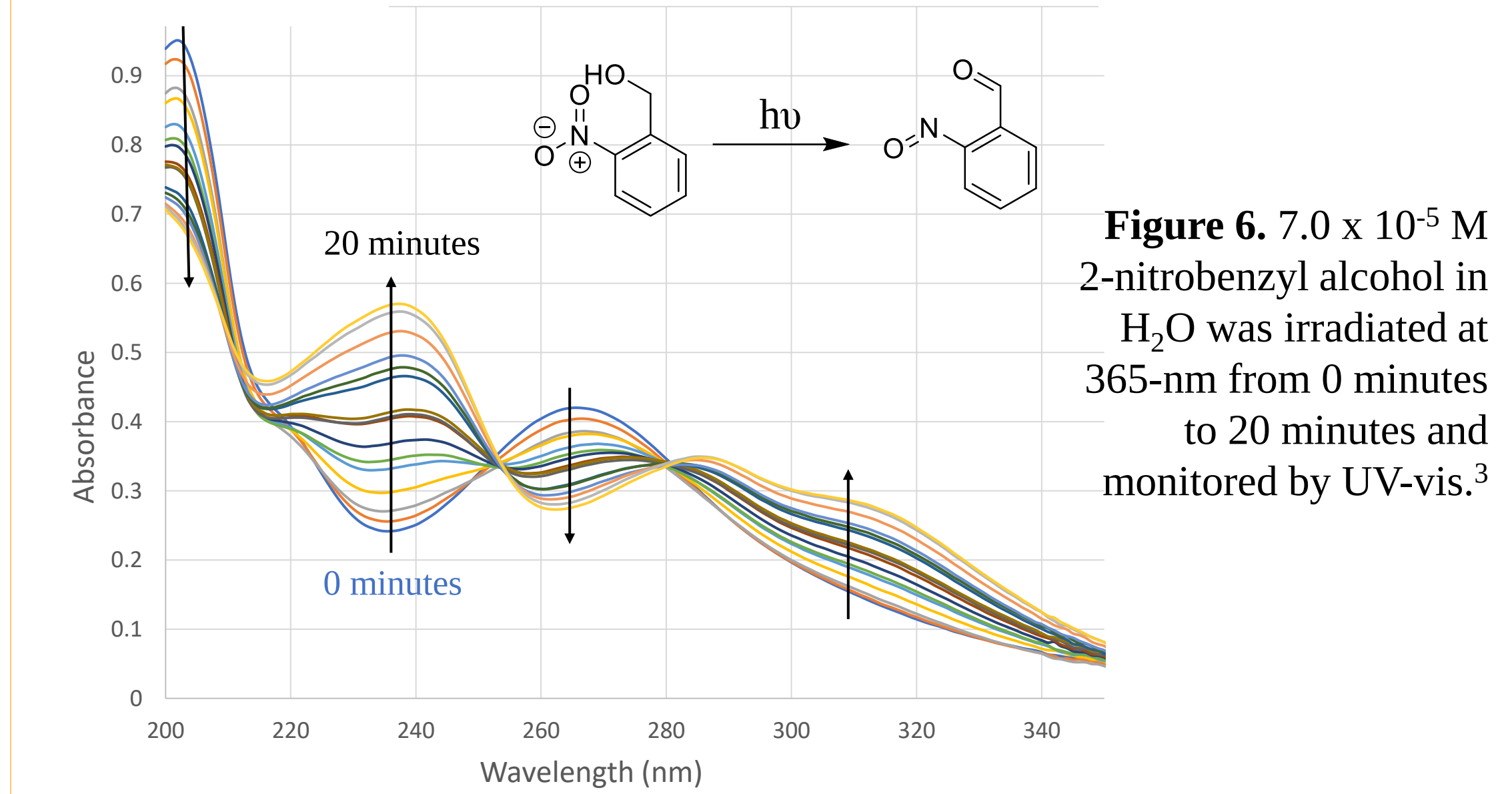
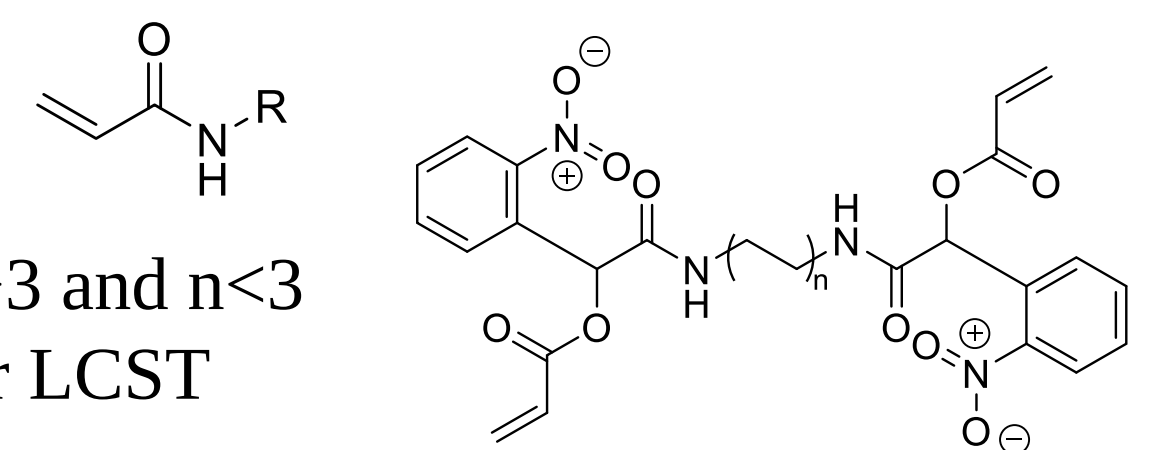


Figure 6. 7.0×10^{-5} M 2-nitrobenzyl alcohol in H_2O was irradiated at 365-nm from 0 minutes to 20 minutes and monitored by UV-vis.³

Future Direction

- Improve purity of PCDA (**2**)
- Vary chain length of PCDA, $n > 3$ and $n < 3$
- Synthesize nanogels with lower LCST
 - Variation of acrylamide monomer
- Design of degradable capsule



Methods

- Synthesis and characterization of **PCDA (2)** (**Scheme 1b.**)
 - 1,6-diisocyanohexane (**1**) (**Scheme 1a.**)
 - Passerini reaction
 - Irradiation monitored by UV-vis (**Figure 1.**)
 - ^1H NMR (**Figure 5.**)
 - FTIR
- Synthesis and characterization of cross linked nanogels
 - BIS linked (3)** (**Scheme 1c.**)
 - Dynamic light scattering (DLS) (**Figure 3.**)
 - PCDA linked (4)** (**Scheme 1d.**)
 - Irradiation monitored by UV-vis (**Figure 2.**)
 - DLS (**Figure 4.**)
- Photolysis of 2-nitrobenzyl alcohol (**Figure 6.**)

DLS

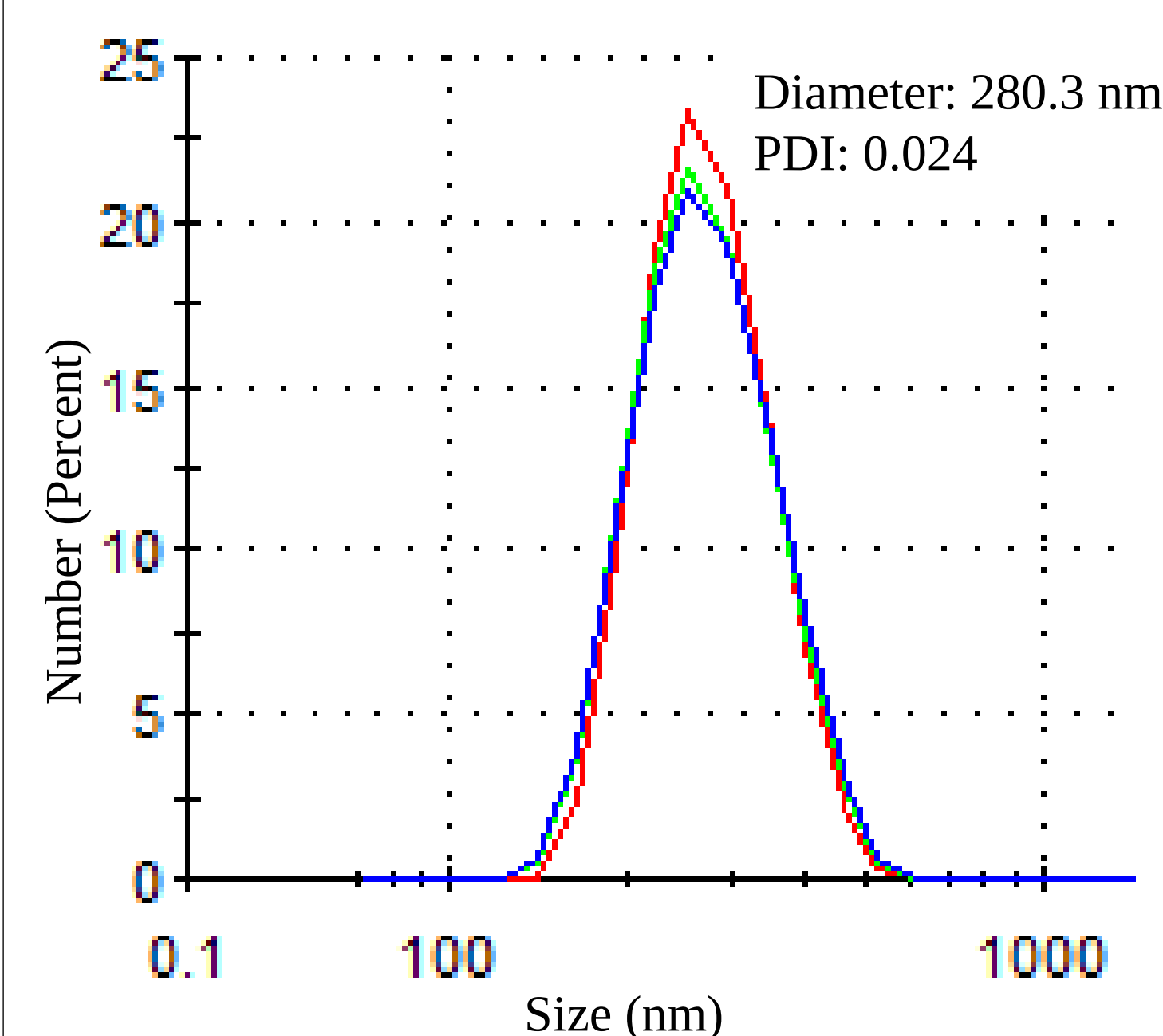


Figure 3. Three dynamic light scattering (DLS) scans of **BIS linked nanogels** in H_2O .

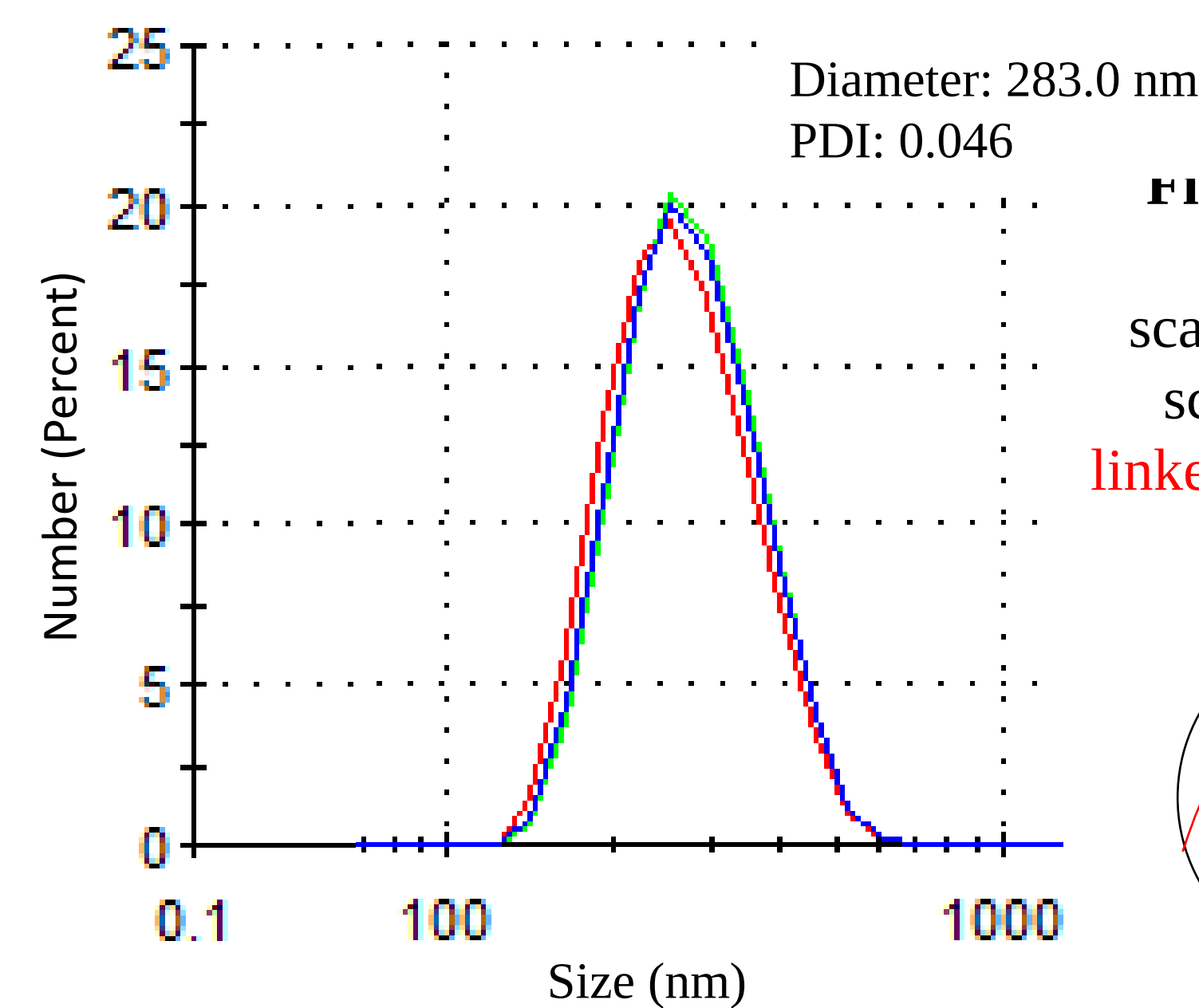


Figure 4. Three dynamic light scattering (DLS) scans of **PCDA linked nanogels** in H_2O .

References

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