

Glowing Gels: The Exploratory Synthesis of Glutamate-derived Rylene Organogelators

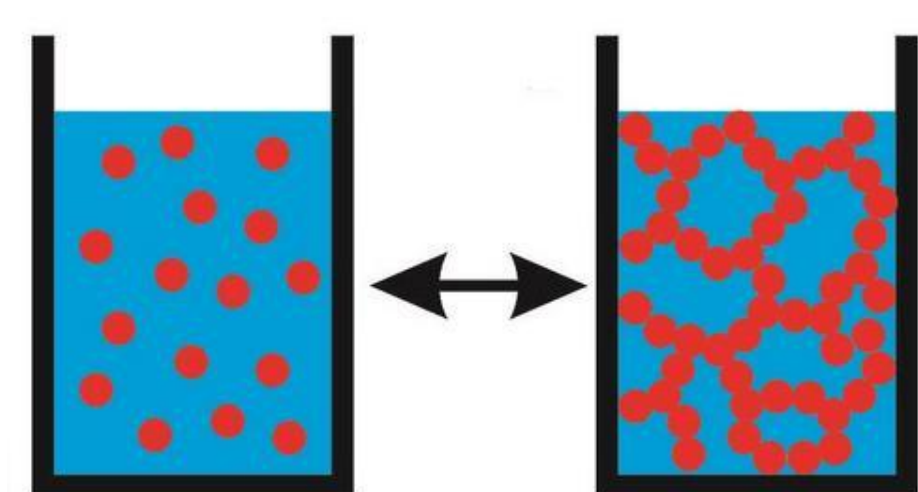
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Abstract:

Perylenediimides and related molecules are well known for their optical properties, which included intense photoluminescence. Low-molecular mass organogels offer a unique method for preparing responsive nanoscale materials. In order to combine the interesting and potentially useful properties of these two classes of materials, the synthesis of ryleneimide dyes with glutamate based lipids has been undertaken. Progress toward the synthesis of the first two prototype systems, based on 1,8-naphthalic anhydride and perylene-3,4,9,10-tetracarboxylic dianhydride, as well as characterization of the resulting molecules will be presented.

What are gels?



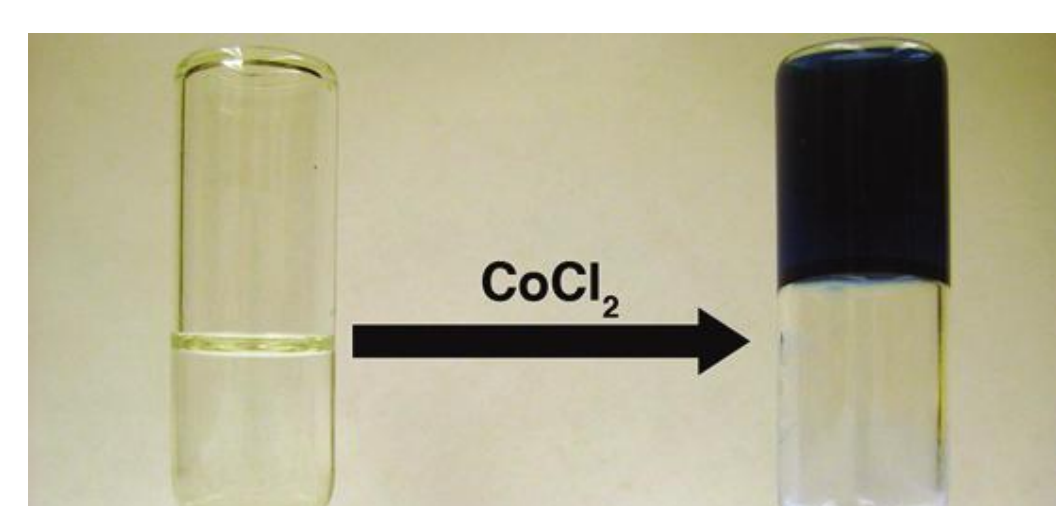
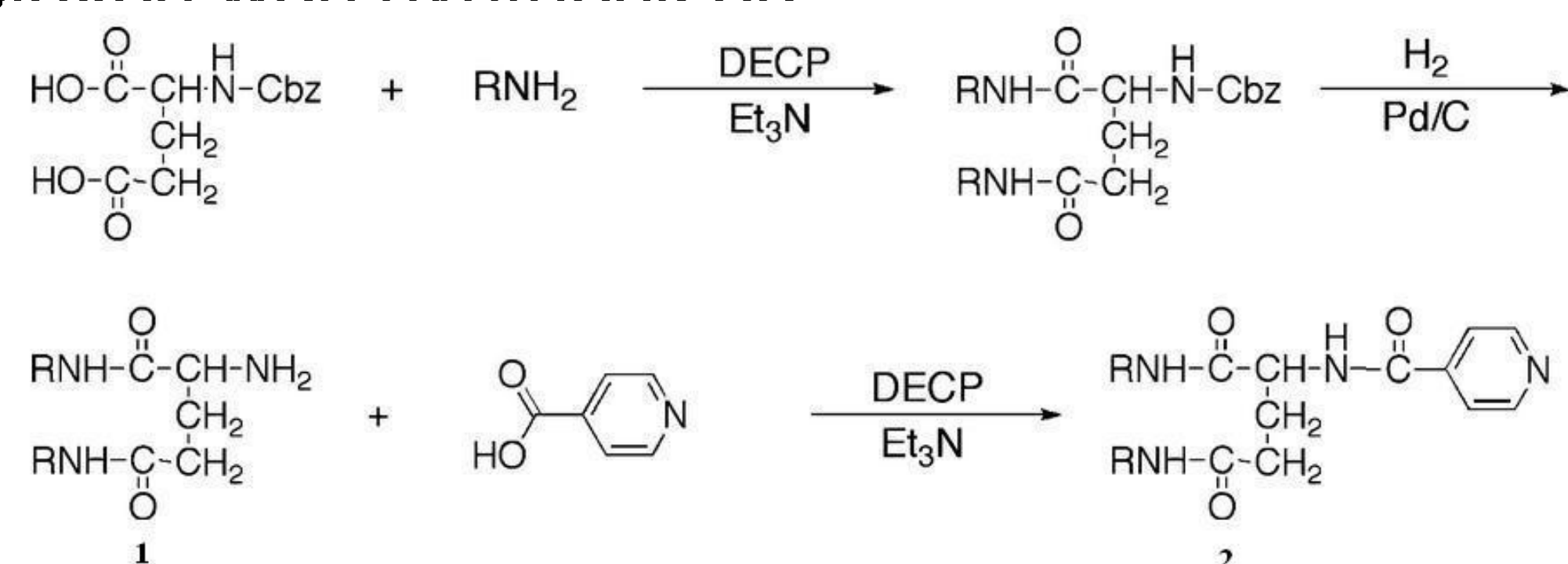
Sol Gel



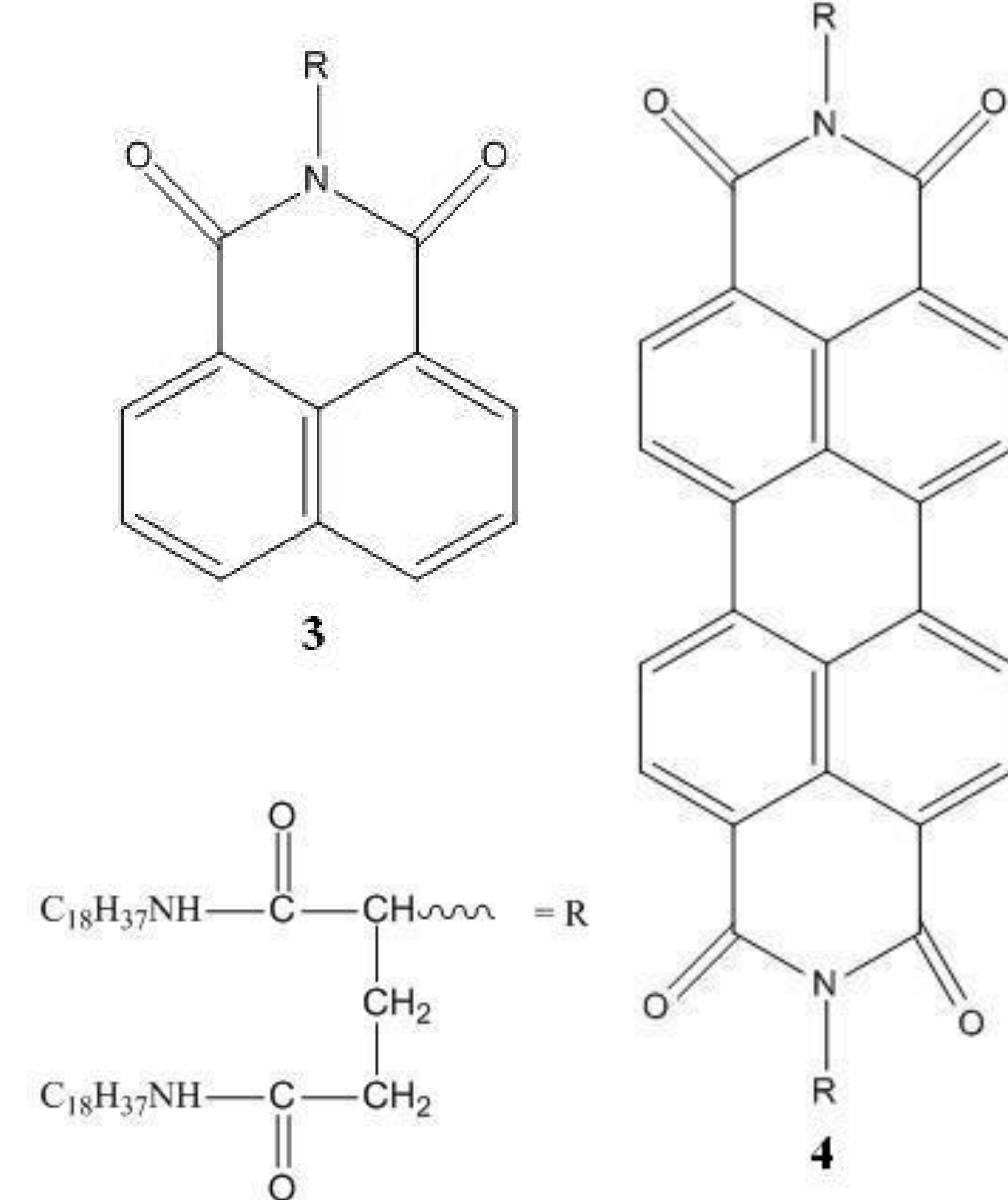
A gel is, by weight, mostly liquid (up to 99.9%) yet behaves like a solid. Gels can be used in cosmetics, as a scaffold for the production of biomaterials, as a method of drug delivery, and as sensors for metals and anions. An organogel is a self-assembling, thermoreversible solid composed of a liquid organic phase suspended in a three-dimensional cross-linked network.

Previous Work:

A new organogelator with twin-tailed glutamate-based lipids and a pyridine headgroup, **2**, capable of forming colored gels with concentrations below C_g upon the introduction of a wide variety of metal salts or complexes was synthesized



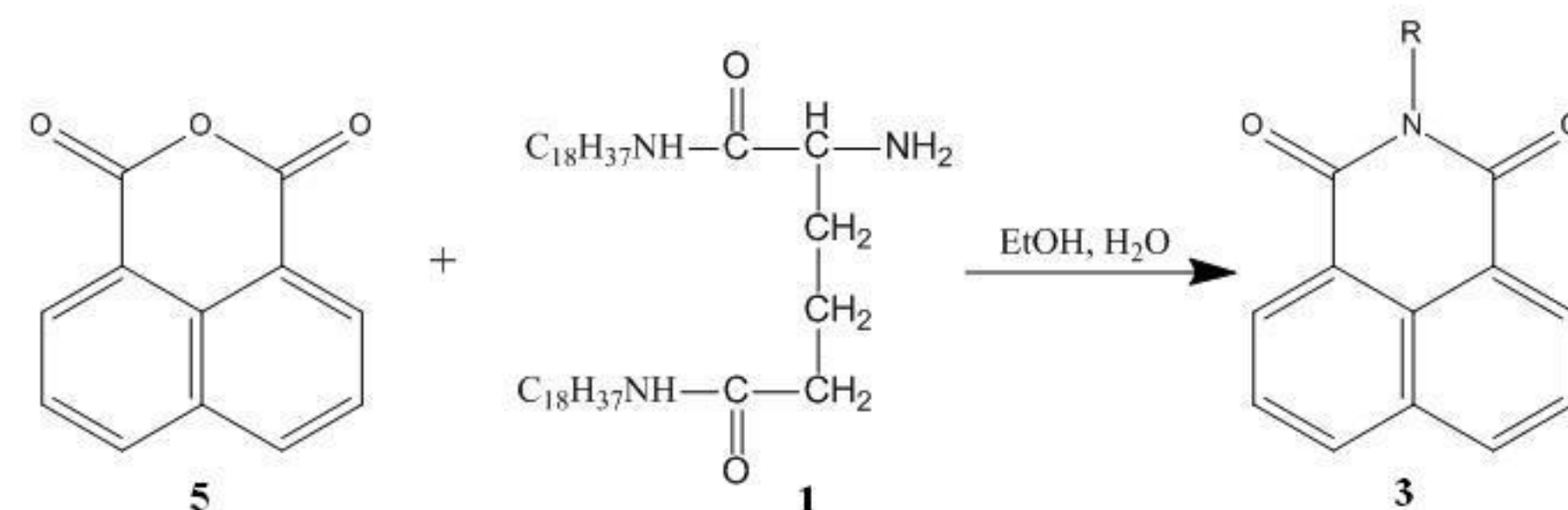
SEM image of xerogel formed from gel of 1 wt % 4 in toluene.



Goal:

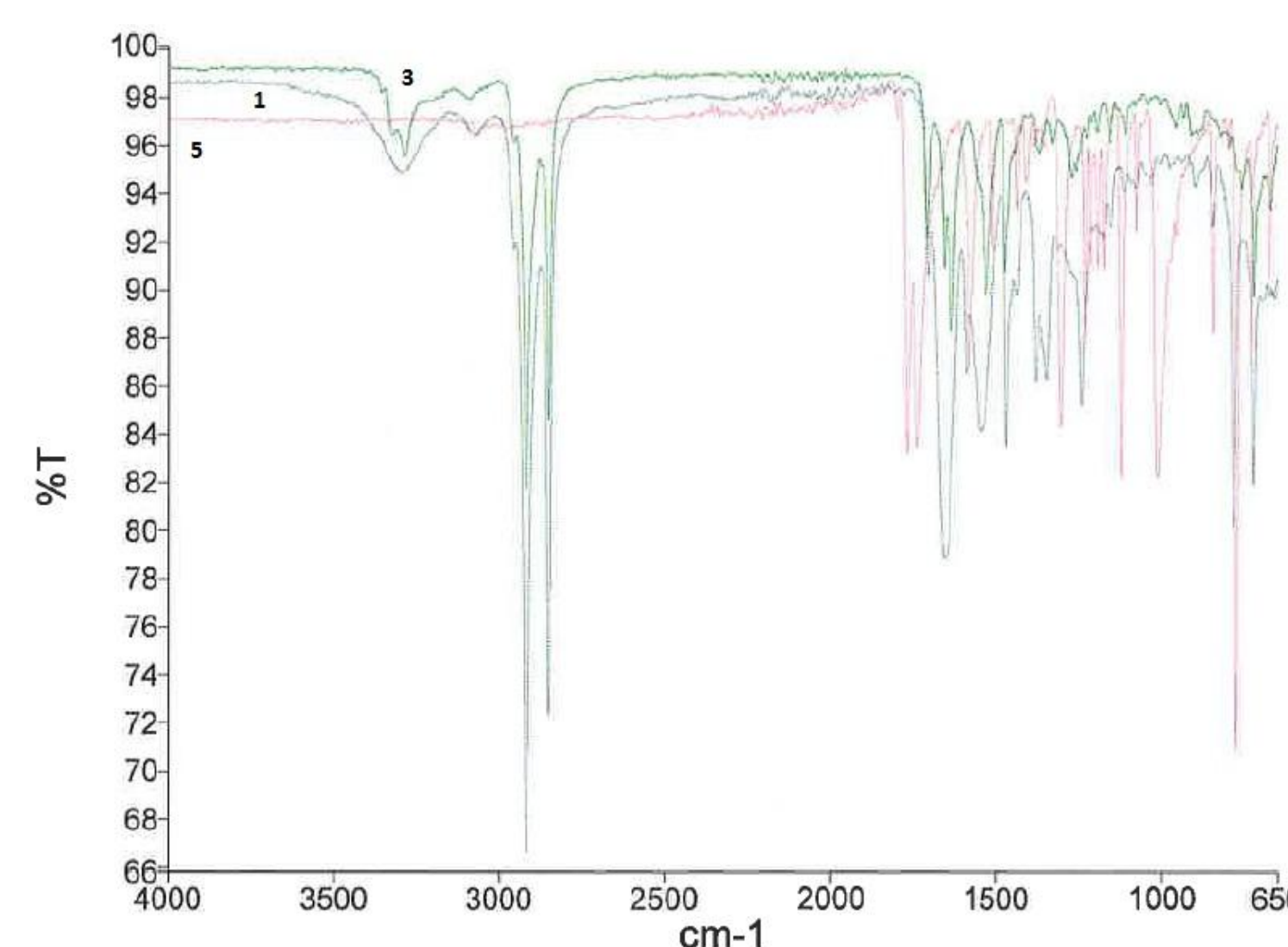
The goal of this experiment was to synthesize two new gelator molecules (**3** and **4**) using the twin-tailed glutamate-based lipid, **1**, from the previous experiment. We hypothesized the gelators would give rise to fluorescent gel systems where the fluorescent properties could be employed as sensors for a variety of anions and other compounds.

Synthesis and Characterization:



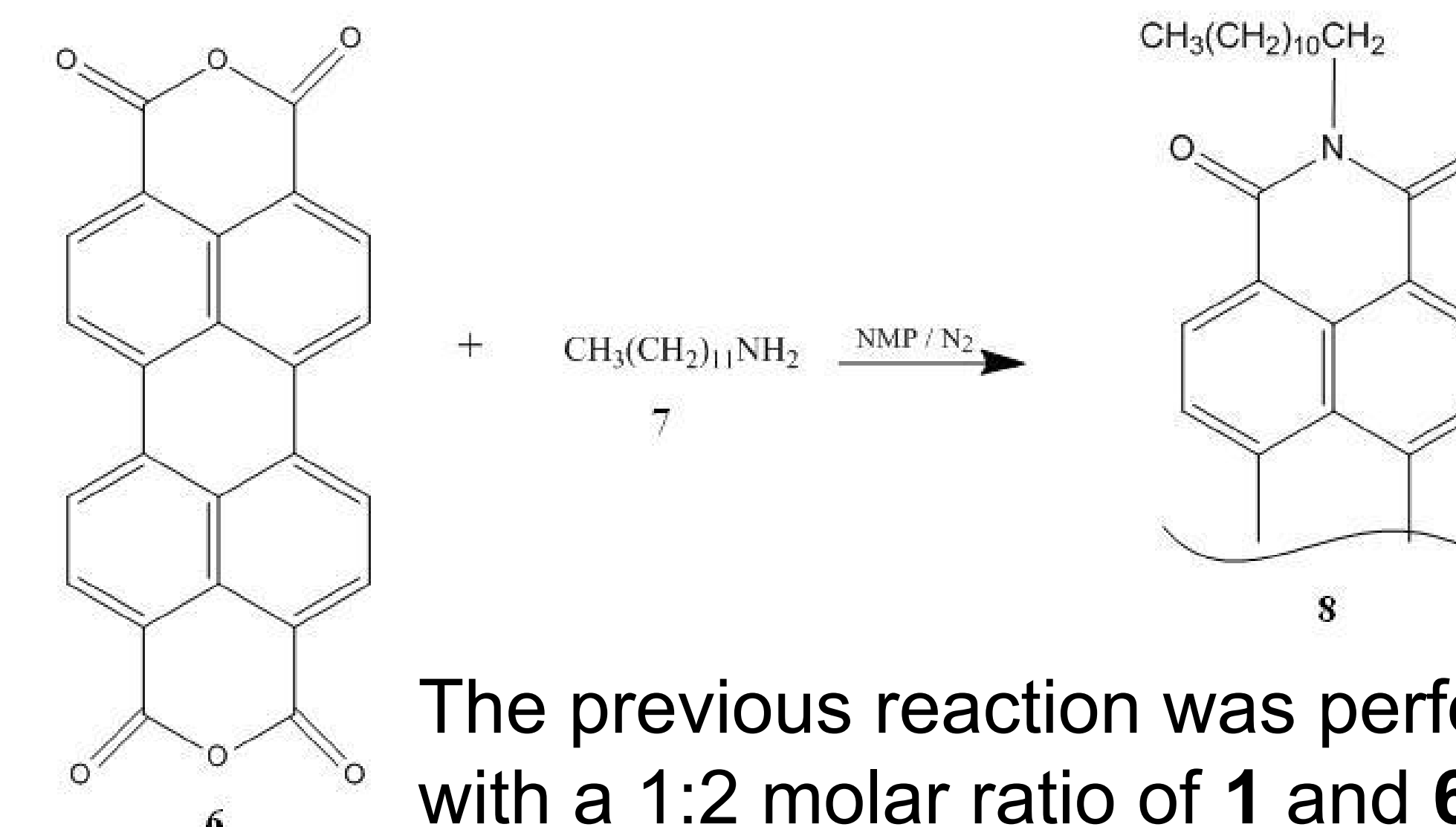
Compound **3** in toluene produces a fluorescent gelatin system.

Compound **3** was prepared via a simple one-step reaction by adding compounds **1** and **5** in a 1:1 molar ratio, dissolving them in an ethanol/water solution, heating to 70°C and holding at that temperature for 90 minutes. The solvent was then removed to yield a light brown solid, **3**. Upon addition of **3** to toluene a translucent and fluorescent gel system was formed.

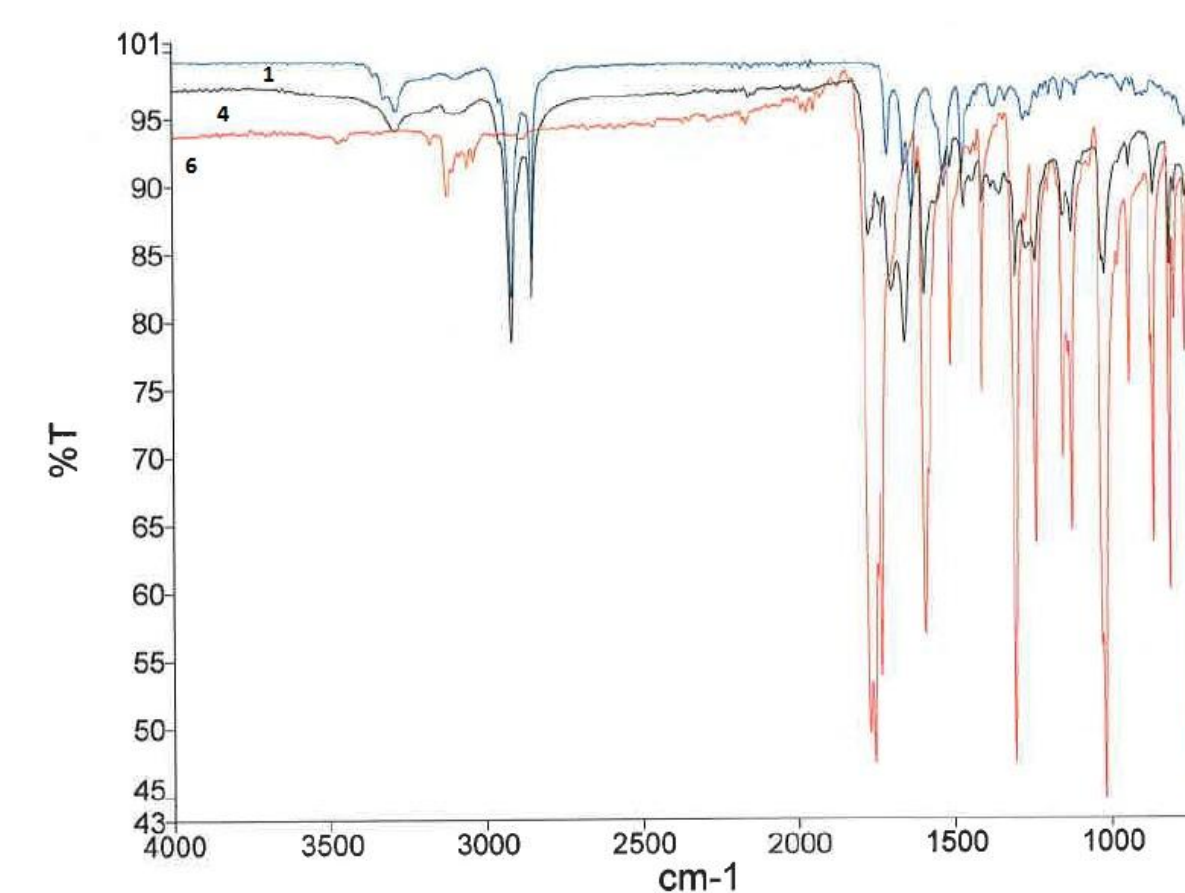
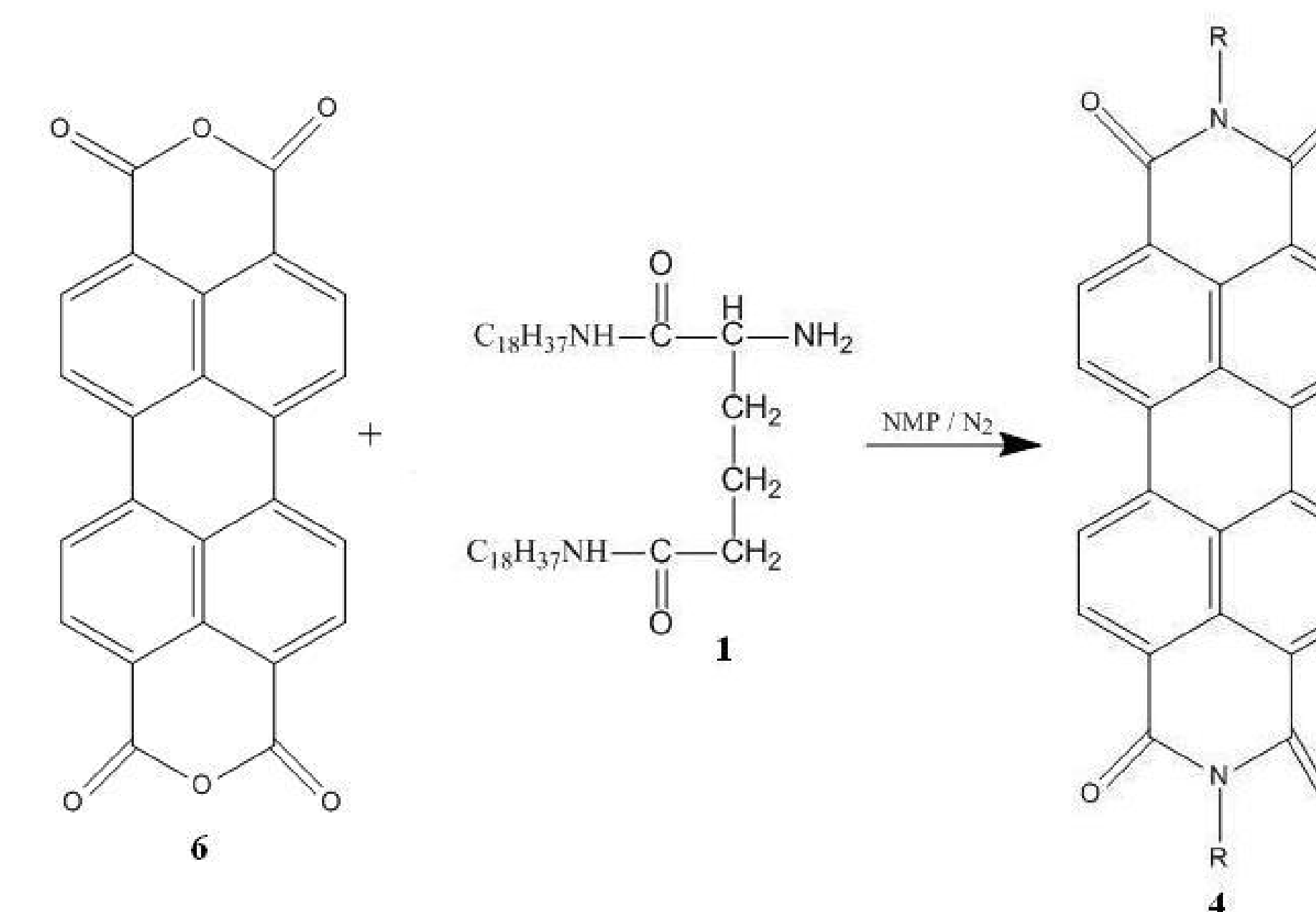
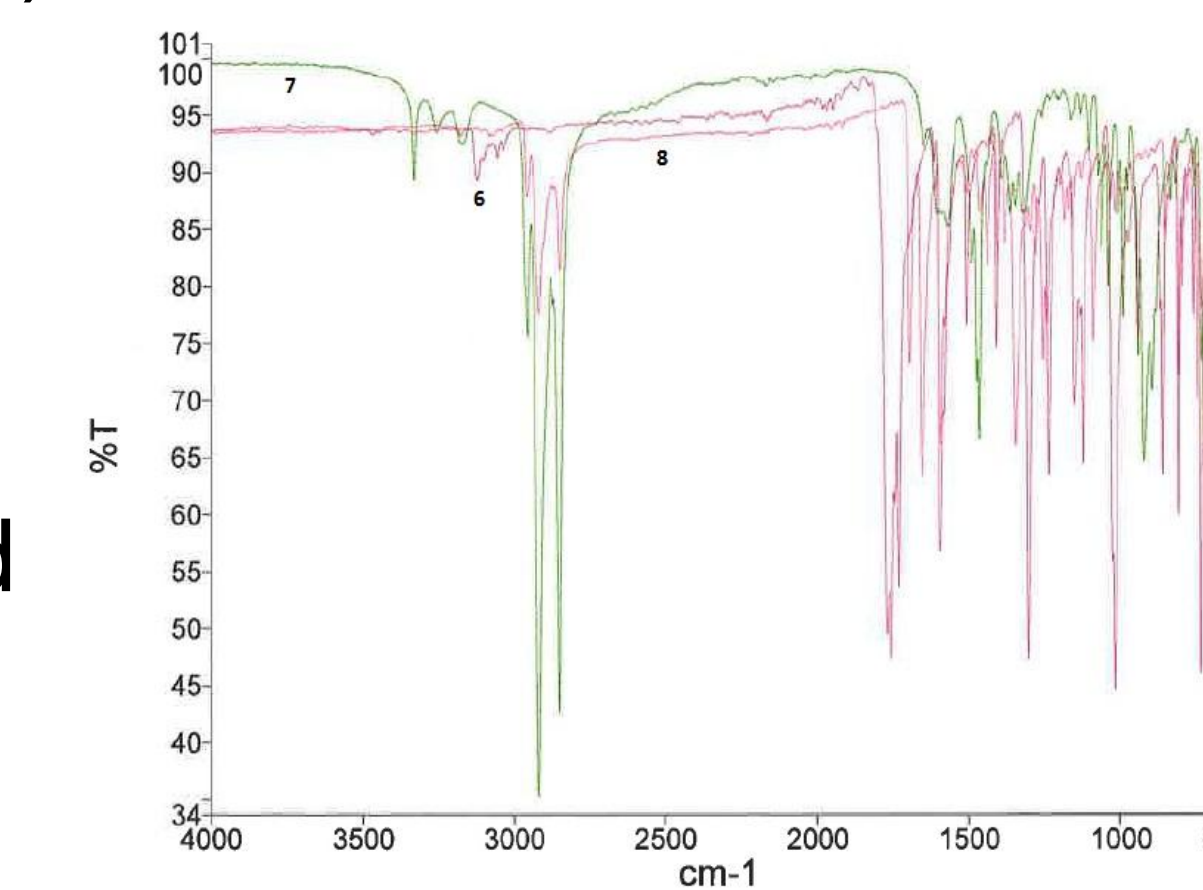


Comparing the IR spectral data of **3** with **5** we see a slight red shift of the carbonyl C=O bands. The alkyl and amide bands from **1** are both preserved in **3**.

Model Reaction



The previous reaction was performed with a 1:2 molar ratio of **1** and **6** but it not yield compound **4**. Several reaction condition changes were made (increased temperature, increased reaction time, reacting under nitrogen) but none lead to the synthesis of **4**. Since obtaining **1** requires a two-step synthesis, a model reaction using laurylamine, **7**, in its place was performed in order to determine the effectiveness of another reaction.



Future Work:

- What is the C_g of **3**?
- Can **4** be made to gel?
- Can **3** and **4** be used as chemical sensors?
- How are the gelator molecules interacting to form the gels?

Acknowledgements

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