SYNTHESIS OF NOVEL CARBAZOLE CONTAINING POLYMERS FOR USE IN ORGANIC ELECTRONIC DEVICES

Background

Two major methods of polymerization used in Industry and Academia

Free radical polymerization
- Easy/robust = industrially friendly
- Fast initiation + termination
- Poor molecular control

Living Polymerization
- Technically demanding
- No termination
- Perfect molecular control

Controlled Polymerization (CRP) takes the best of both methods, yielding a robust, industry friendly method of mass producing polymers while allowing for exceptional molecular control to make finely tuned materials for advanced applications.

Organic Electronics

Organic electronics made from carbon-based materials such as polymers and small molecules are industrially relevant and cost effective to produce.

Organic Light Emitting Diodes (OLEDs) and Organic Thin Film Transistors (OTFTs) are both examples of organic electronic devices that can be made from inherently flexible polymeric materials

Major advantages in production of materials for organic electronic applications is that they can be processed inexpensively from solution.

Synthesis of Carbazole Containing Polymers

The copolymerization of 2-(9H-Carbazol-9-yl)-ethyl methacrylate (MVAK) was carried out using Nitroxide Mediated Polymerization (NMP), a scalable technique which also allows polymers to be synthesized with a very narrow molecular weight distribution.

Synthesising polymers with Carbazole moieties are useful because some carbazole-containing compounds exhibit relatively high charge carrier mobility and high thermal and photochemical stability

Methodology

Reactions Procedure

- Copolymerization of MVAK was carried out by Nitroxide Mediated Polymerization (NMP) in a 50mL reactor flask at 90°C using 0.02g of NHS-BlocBuilder as an initiator.
- In each reaction, approximately 1.0g of MVAK was used with 5-10% of controlling comonomer added to the system along with 5mL of solvent.
- Samples were taken over expanding time intervals to test for conversion and polymer dispersity over time. Products were precipitated in hexanes and collected utilizing filtration.
- Monomer conversion was determined by gravimetry and analysis of 1H NMR spectra through observing the relative ratios of vinyl protons to aromatic protons.

Results

Nuclear Magnetic Resonance Spectroscopy (1H NMR)

Proton NMR results for testing conversion were not as promising as physical observations.

Conclusions

- Initial results conclude that the copolymerizations of MVAK is possible.
- Polymer dispersity of the MVAK / Styrene system is below 2.0 is significantly lower than any previously published value to date.
- NMR results were disappointing, but these results can be attributed to lack of monomer purity.

References

[1] Lessard, B. Nitroxide Mediated Polymerization: From Fundamentals to Applications in Materials Science; Royal Society of Chemistry, 2015, pp. 472-478
[3] Y. Tao et al.; Synthesis and photoluminescent property of star polymers with carbazole pendant and a zinc porphyrin core by ATRP; Polymer (52), 2011, pp. 4261-4267

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Ongoing Work

- Re-crystallization of monomer for greater purity
- Different percentages of controlling co-monomers
- Testing on different systems such as VAK
- Exploration of optical and electrical properties of these novel materials