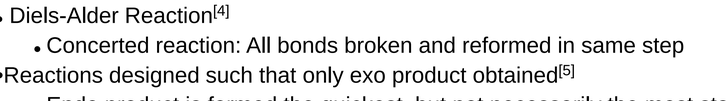
Synthesis and Characterization of Polymeric Protein Mimic Precursors

Tammy Van, Brittany M. deRonde, Leah Caffrey, Gregory N. Tew
Department of Polymer Science and Engineering
University of Massachusetts Amherst, Amherst, MA 01003

Polymers

Overview:

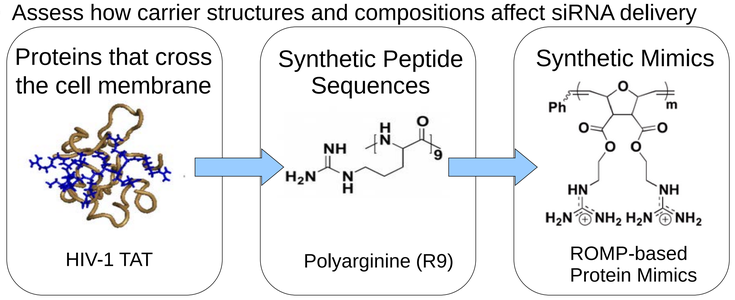
- A polymer is a macromolecule composed of multiple monomers (subunits)
- There are two types of polymers: natural and synthetic
- Natural polymers (a.k.a. biopolymers) are formed by living organisms i.e. proteins, lipids, nucleic acids
- There are two types of synthetic polymers: inorganic and organic
- Inorganic polymers are usually used as sealants, adhesives, and lubricants[3]
- Organic polymers are comprised of carbon-based small molecules



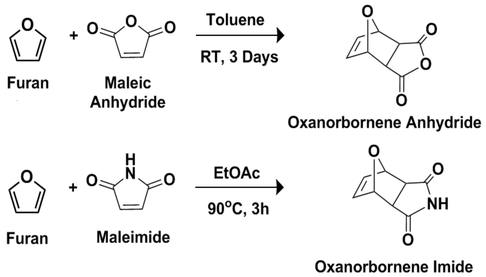
Design of Protein Mimics

Motivation: To use polymer design to mimic delivery capabilities of proteins and peptides

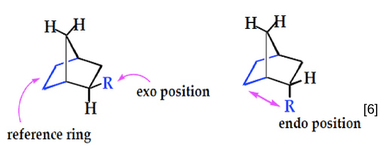
- Insight into important structural features for translocation, membrane interactions, complex formation and cargo delivery
- Tunable polymeric structures
- Assess how carrier structures and compositions affect siRNA delivery



Starting Material Synthesis

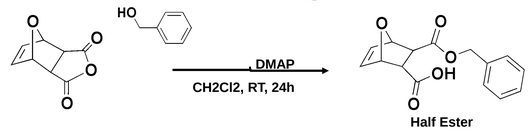


- Diels-Alder Reaction[4]
  - Concerted reaction: All bonds broken and reformed in same step
- Reactions designed such that only exo product obtained[5]
  - Endo product is formed the quickest, but not necessarily the most stable; Thus, exo product is desired



[6]

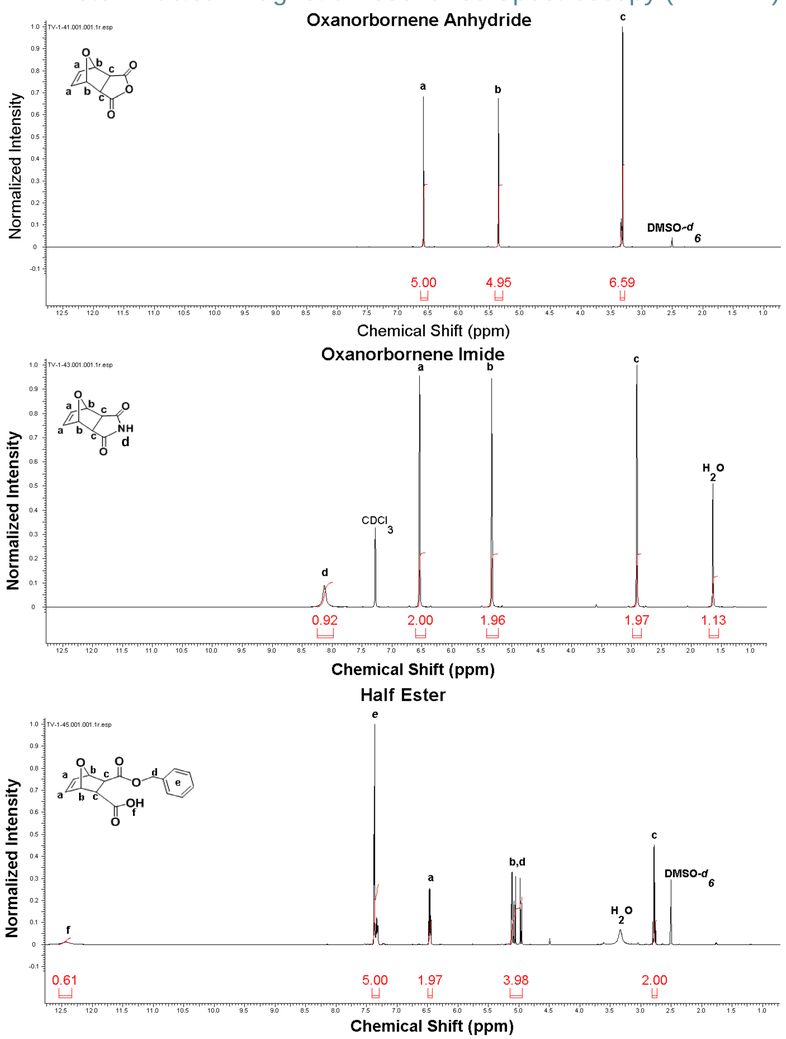
Half Ester Synthesis



- DMAP-Catalyzed esterification reaction, Nucleophilic substitution reaction[4]
- Reacted Oxanorbornene Anhydride (exo conformation) with Benzyl Alcohol
- CH_2CL_2 needs to be freshly distilled prior to setting up the reaction
- Distilled solvents and nitrogen flow still used as precaution
- Final product is partially soluble in DCM, so must wash final product with cold DCM to limit product's solubility in the wash solvent

Molecular Characterization:

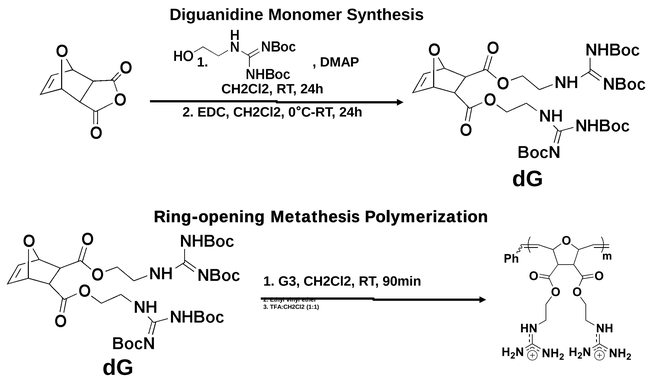
Proton Nuclear Magnetic Resonance Spectroscopy (^{1}H NMR)



Summary

- Learned basic chemistry laboratory practices
  - Completed Lab & Fire Safety Training
  - Learned proper lab attire
- Successfully synthesized Oxanorbornene Anhydride and Oxanorbornene Imide using Diels-Alder chemistry
- Learned how to characterize the chemical compositions of molecules using ^{1}H-NMR[4]
- Learned how to synthesize half-ester intermediates using an esterification reaction

Future Work



- Further practice with Half ester synthesis
- Further practice using ^{1}H NMR machines and analyzing ^{1}H NMR spectrum
- Use FT-IR spectra to analyze functional groups present in molecules
- Learning monomer synthesis
- Learning polymer synthesis

Acknowledgments

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Tew Research Group

References

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[3] Young, R.J., Lovell, P.A. *Introduction to Polymers, 3rd Edition.* CRC Press. 2011.
[4] Bruice, P.Y. *Organic Chemistry 5th Edition.* Prentice Hall. 2006.
[5] Rulisek, L. *et. al. JOC.* **2005,** 70, 6295.
[6]Chem 322b Chapter 13 -. (2010, February 20). Retrieved December 1, 2014, from http://thescwiki.wikidot.com/chem-322b-chapter-13