

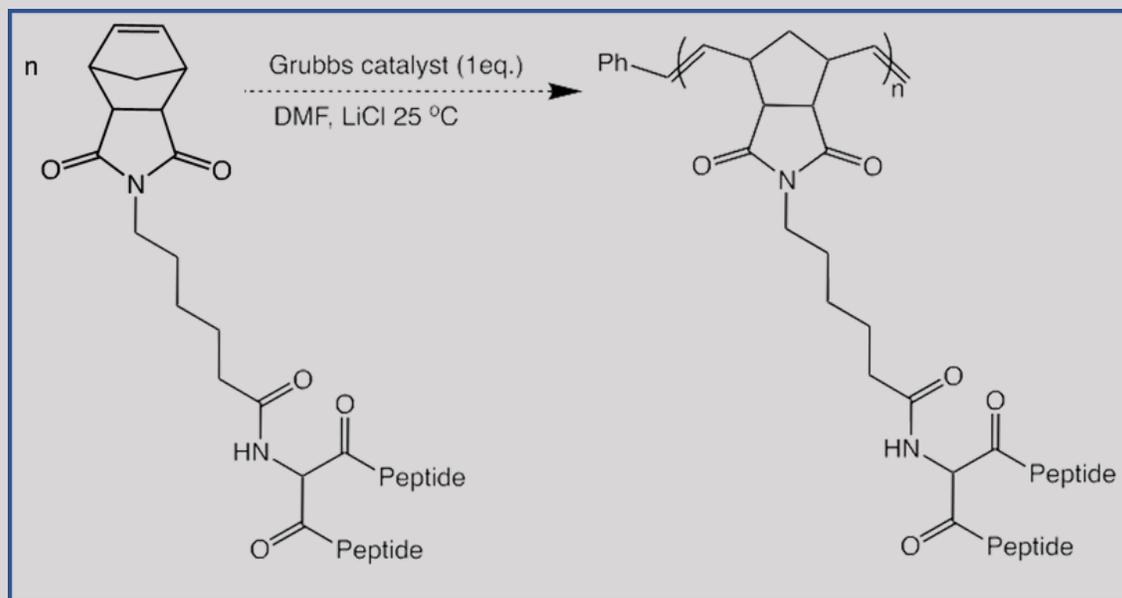
RAFT and ROMP based enzyme responsive amphiphiles as building blocks for smart polymeric nanocarriers

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These three months of an exchange program at Northwestern University have benefited me in learning new polymerization techniques, such as ring-open metathesis polymerization (ROMP), which can be used to construct polymers for diverse applications. This chain growth polymerization converts cyclic olefins to a polymeric material in the presence of transition metal-based complexes such as Ti, Mo, W, Ta, Re, and Ru complexes. Therefore, transformation reactions of both polycyclic olefins such as norbornene (NB), norbornadiene, dicyclopentadiene, and low-strain cyclic olefins allow extension of the range of attainable block copolymers.

In particular, Gianneschi's lab has observed that norbornenyl-modified peptides polymerized via ROMP yield brush polymers with exceptional resistance to proteolytic digestion while retaining their bioactivity. It was also demonstrated that their proteolytic susceptibility can be tuned by adjusting the density of the polymer brush. Taking inspiration from these observations, we planned to synthesize high-density protein-like polymers (PLPs) having di-peptide attached to each norbornene monomer, but could not complete the synthetic procedure due to certain challenges that are faced in this project.



Scheme 1: Synthetic route for the polymerization of high density peptide monomer(left) via ROMP polymerization using Grubbs 2nd generation catalyst.



Rathee with Gianneschi lab member Dr. Julia Oktawiec

In addition to that, this research collaboration between Tel Aviv University and Northwestern University has also given me the opportunity to witness the Liquid Cell Transmission Electron Microscopy (LC-TEM) technique, which can examine the materials in a native state, allowing dynamic observations. For this technique to use the sample should be liquid or suspended in liquid and have to be tightly sealed to withstand the space-like vacuum of the instrument (Fig.1.). My Ph.D. research is focused on studying the self-assembly and disassembly of micelles and hydrogels formed from di- and tri-block copolymers. So, with this additional understanding of the LC-TEM technique, one can obtain real-time information about the morphology of the assembled structures, their kinetics, dynamics, and their response to the activating enzymes.

This characterization data is highly relevant for designing such amphiphiles and their assemblies for their potential application as controlled drug delivery systems. We are looking forward to working collaboratively by combining the expertise of Gianneschi's group on the LC-TEM with our expertise in designing polyethylene glycol (PEG) based stimuli-responsive nanocarriers.

Northwestern University

