Chemically recyclable polymers based on olefin metathesis

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Abstract: The linear polymer economy stands as a major roadblock on the way to reducing humanity's carbon footprint. It is a testament to this fact that out of 6 billion tons of plastic waste generated, only 9% had been recycled until 2015. Several challenges exist in transitioning to a circular polymer economy: worsening properties of plastics over the course of repeated recycling, high energy costs of recycling processes, and difficulty in sorting plastic waste into different streams. Chemical recycling to monomer (CRM) is emerging as an attractive route to overcoming some of these challenges. However, despite several reports of materials capable of undergoing efficient CRM, there exist only a few systems that combine all of the following desirable characteristics: ease of polymerization/depolymerization, a wide range of thermomechanical properties, and chemical functionalities, and hydrolytically and thermally stable polymer backbones. We have recently demonstrated a new, robust olefin metathesis-based polymer system capable of undergoing CRM. This is achieved by utilizing a 5,6-*trans* cyclobutene fused cyclooctene (*t*CBCO) motif to obtain low ring strain cyclic olefin monomers which can undergo efficient polymerization/depolymerization under mild conditions.

This talk will discuss the effect of different fused rings on the ring strain in cyclooctene, synthesis of *t*CBCO monomers, thermodynamics of polymerization, and the mechanism of depolymerization. Thermomechanical properties for a range of different *t*CBCO based polymers will also be discussed. The versatile platform here offers not only exciting new candidates for the future of sustainable materials but also offers new insights into regulating ring strain in cyclic monomers- which is a key to designing new CRM materials.