Solvay Seminars in Macromolecular Science & Engineering

Macromolecules Innovation Institute (MII)

VIRGINIA TECH

Prof. Yan Xia

"Building and Breaking Macromolecular Ladders to Develop Microporous Membranes and Mechanically Responsive Polymers"

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Host: John Matson

Abstract: In the pursuit of unusual polymer structures with unique properties, we developed Catalytic Arene-Norbornene AnnuLation (CANAL) to synthesize rigid ladder polymers from readily available norbornenes and aryl bromides. Efficient CANAL polymerization produced ladder polymers with molecular weights above 1 MDa, various functionalities, and contorted conformations, despite the formed strained ring in each repeat unit. These ladder polymers exhibited high surface areas, high microporosity (pore width < 1 nm), and surprisingly high thermal stability up to 400 °C without detectable T_g. Membranes were fabricated and showed high performance for gas separations. These materials also allowed us to investigate gas transport in glassy polymers. In another type of ladder-shaped polymers, we developed a unique family of insulating polymers that respond to mechanical stress and undergo rapid macromolecular unzipping to form semiconducting polyacetylene with > 100 conjugated olefins. This design not only leads to unprecedented materials that sense and adapt to mechanical stress by transforming a whole array of their intrinsic properties, but also allows us to understand mechanotransduction along polymer chains.

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Bio: Yan Xia received his undergraduate degree from Peking University ('02) and MSc from McMaster University ('05). He then obtained his PhD in Chemistry from Caltech in 2010, working on cyclic and bottlebrush polymers under the guidance of Profs. Robert Grubbs and Julie Kornfield. Following his PhD, he worked as a senior chemist at Dow Chemical for one and a half years and then a postdoc associate with Prof. Brad Olsen at MIT Chemical Engineering. He joined the chemistry faculty at Stanford in the summer of 2013. His research interest lies in the design, synthesis, and manipulation of organic materials and polymers, driven by new synthetic capability, rational molecular design, and curiosity.

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