Challenges and Opportunity of Polymer Mechanochemistry

报 告 人: Prof. Roman Boulatov, Department of Chemistry, University of Liverpool

报告时间: 2019-9-11, 10:00 am

报告地点: 工物馆 324A 会议室

主办单位: 化学工程系

报告摘要

Stretching a rubber band breaks some of its covalent bonds. Similarly, existing covalent bonds continuously break and new bonds form in tires of a moving car. These are examples of mechanochemistry, a class of widespread phenomena in which directional macroscopic motion (usually) accelerates chemical reactions by distorting molecular shapes. The transient nature of such molecular strain means that only large rate-accelerating distortions produce mechanochemistry. Quantitative molecular understanding of mechanochemistry requires the knowledge of (a) how the molecular geometry and the environment convert macroscopic motion into molecular distortions and (b) how such distortions change chemical reactivity. Several approaches exist to decouple these two components of mechanochemistry, ranging from carefully designed small-molecule models, through micromanipulation techniques and the use of ultrasound. The presentation will discuss these approaches and their respective contributions to the ongoing effort to develop a conceptual foundation of mechanochemistry and describe how they help us explain the existing, industrially important manifestations of mechanochemistry and guide the design of new materials and processes that exploit mechanochemistry.

References

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报告人简介

Roman Boulatov received his PhD from Stanford under James Collman for work on metalloporphyrins, particularly for catalytic low-temperature oxygen reduction. After a 2-year postdoc at Harvard with George Whitesides, where he explored unconventional means of energy conversion, he started his independent research program at University of Illinois, Urbana Champaign in the broad field of covalent mechanochemistry. His group's major accomplishment at UIUC was the development of a method of inducing mechanochemical reactions without the need for coupled macroscopic motion. This method enabled experimental studies of mechanochemistry with a molecular-level resolution and revealed that the range of mechanochemical responses extends beyond the conventional load-accelerated dissociation of covalent bonds. In 2012 his group moved to the University of Liverpool, where it continues to integrate synthesis, physical measurements, quantum-chemical and empirical calculations to develop a general conceptual framework of polymer mechanochemistry. His group works closely with industrial partners to exploit these unique capabilities to accelerate the development of new polymer materials and polymer processing methods.