Surface Science Meets Homogeneous Catalysis. Surfaces as Ligands and Activators for Polymer Construction and Deconstruction

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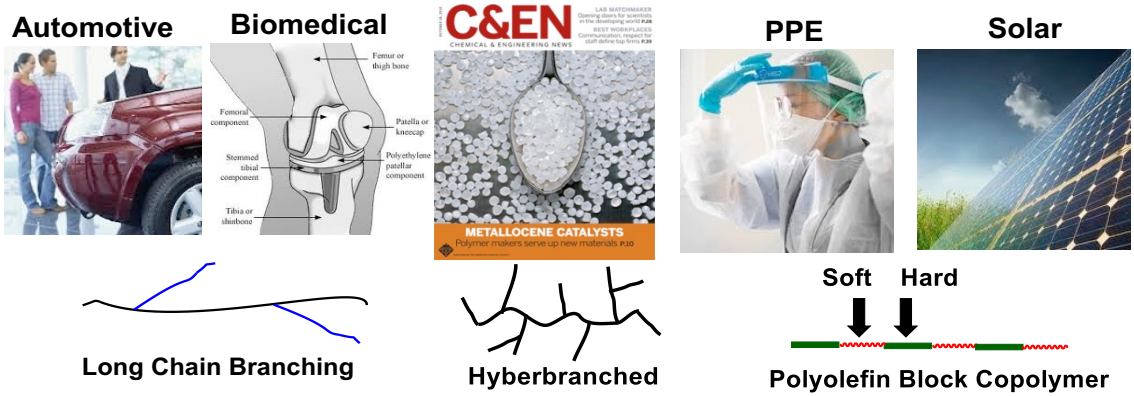
When chemisorbed upon special surfaces, the reactivity of many organometallic molecules is dramatically altered in ways that are not well understood. High activities for known and unknown catalytic reactions are illustrative consequences of this modified reactivity. This lecture focuses on the intricate non-covalent and covalent multi-center interactions that modulate these catalytic processes and the advanced experimental and theoretical techniques now enabling the elucidation of their structures and reactivity, with a primary focus on olefin polymerization, hydrogenation, and depolymerization. This knowledge has enabled the industrial production of approximately 40 billion kg of high-performance materials. Specific interrelated topics include: 1) Catalytic chemistry of molecular d^0 catalysts anchored on/activated by surfaces vis-à-vis those operating in homogeneous solution, 2) Definitive structural characterization of these catalytic centers on "super-acidic" sulfated oxide surfaces. 3) Application of this knowledge to design rules for next-generation supported catalysts, for novel and useful polymerization and hydrogenation/depolymerization processes, such as detoxification of gasoline, facially selective aromatics hydrogenation, and polyolefin creation or deconstruction. The lecture concludes with thoughts about progress towards polymers for a future circular economy.

Catalysis Science ➡ New Polyolefin Materials



New Catalytic Principles & Polymer Science Relevance to Future Circular Economies