Yoshie LAB.

[Dynamic Polymer Materials]

Environment-Conscious Polymeric Materials Science

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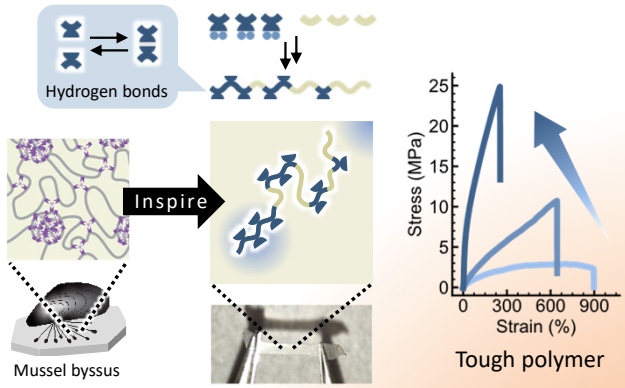
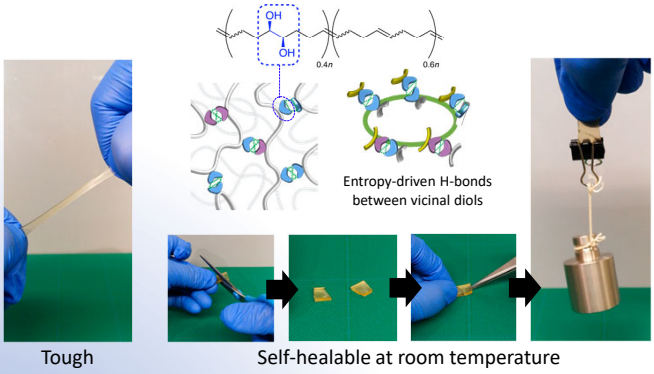
We create new high-performance materials such as tough self-healable elastomers, robust nanocomposites, and environment-responsive degradable polymers by dynamically controlling hierarchical structure of polymeric materials spanning from molecular to mesoscopic scales.

Bio-inspired tough polymer



Mussels have a string-like tough organ called *byssus* to fix themselves to rocks. Inspired by the multiphase structure formed by dynamic crosslinks in byssus, we developed a new material with high mechanical toughness.

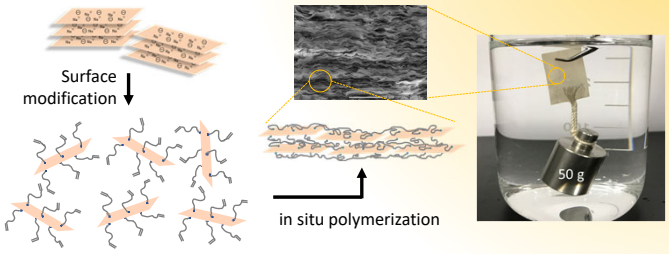
Tough rubber that heals by itself



What if materials like rubber can heal their wounds by itself? It will greatly prolong the materials' lifetime. We discovered that hydrogen bonds between very simple chemical motifs (vicinal diols) make a rubber mechanically tough and self-healable.

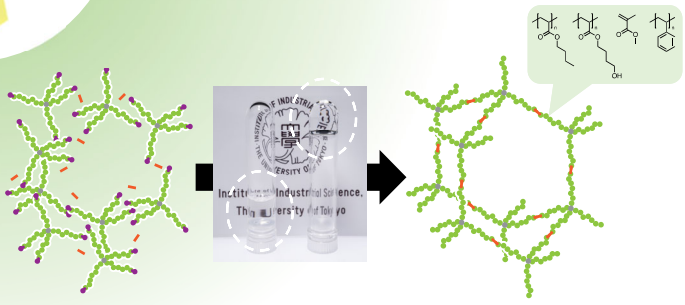
Functional materials by tuning dynamic structure

Rigid & water-proof organic/inorganic nanohybrid



Nacre in sea shells is an organic/inorganic nanohybrid consisting of alternating layers of plate-like minerals and organic polymers and is known for its high rigidity and low permeability. However, artificial nacre-mimetic materials are often water-sensitive because of high hydrophilicity of the inorganic component. We developed a rigid, water-proof nanohybrid by combining the surface modification and in situ polymerization techniques.

Near-ideal polymer network



Elastic polymer materials such as rubbers and gels are made of numerous polymer chains cross-linked with each other, forming 3D-network. However, the network structure is usually highly heterogeneous, which has negative influences on the materials' performance. We developed a novel synthetic method to make highly homogeneous polymer networks.