The road to intrinsically dynamic materials: disulfide chemistry as a solution

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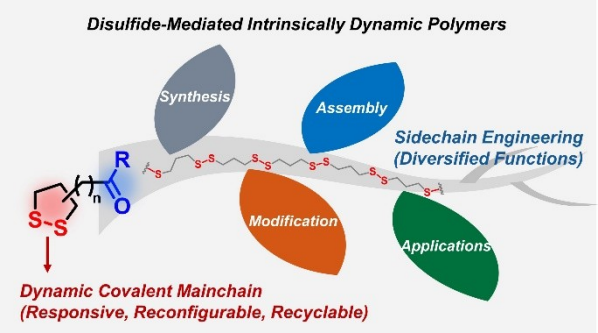
Understanding dynamic chemistry systems in Nature inspires chemists to design biomimetic synthetic materials. Disulfide bonds, the bonds that tie peptides, feature their dynamic covalent nature, that is reversible covalent bonds. Here we propose that making polymers with disulfide bonds can be a solution towards intrinsically dynamic materials. Unlike traditional plastics and noncovalent (supramolecular) polymers, poly(disulfides) can simultaneously exhibit chemical recycling ability and excellent mechanical performances. We will focus on the poly(disulfides) derived from thioctic acid, a natural small molecule, to show the promising applications of these intrinsically dynamic materials in self-healing elastomers, adhesives, and actuators [1-5]. Then I will move to our recent discovery that hydrogen bonds are essential in the control of disulfide chirality and enable stereodivergent chirality transfer. We find that the formation of S−S---H−N hydrogen bonds in solution can drive conformational adaption to allow intramolecular chirality transfer, while the formation of C=O---H−N hydrogen bonds results in supramolecular chirality transfer to form antiparallel helically self-assembled solid-state architectures [6].



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