Peptide-Based Materials

H₂S-Releasing Peptide Gels
Peptide-based materials can deliver drugs, proteins, and other therapeutics in a localized manner. We use both supramolecular and covalent peptide-based gels in a variety of biomedical applications.

Thermoresponsive elastin-like peptides
Elastin-like peptides (ELPs) are used as thermoresponsive components in biomaterials due to their sharp phase-change properties upon heating. Conformational changes from random coil to β-turn can be observed using circular dichroism spectroscopy. We have synthesized ELP-based peptide dendrimers with molecular weights exceeding 14,000 g/mol.

Peptide Nanocoils
We discovered a set of three constitutionally isomeric peptide H₂S-donor conjugates (PHDCSs), each containing two glutamic acid residues (E) and two lysine residues modified with H₂S-releasing SATD groups (K). The PHDCs self-assemble in water into different morphologies based on the specific amino acid sequence. They also release H₂S at different rates, leading to differential bioactivity in cell assays.

Bottlebrush Polymer Synthesis

Importance of the Anchor Group
The three-dimensional shape of bottlebrush polymers depends largely on the degree of polymerization of the backbone, which is limited by the rate of macromonomer propagation and the lifetime of the active catalyst species. Here we show that the choice of anchor group has a significant effect on ROMP grafting-through polymerization kinetics, where propagation rates are related to the energy of the highest-occupied molecular orbital centered on the reactive norbornene doublet.

Tapered Bottlebrush Polymers
We prepared tapered [cone-shaped] bottlebrush polymers for the first time by using a strategy termed sequential-addition of macromonomers ring-opening metathesis polymerization (SAM-RoMPP). Polystyrene macromonomers with molecular weights that increased from 1 to 10 kg mol⁻¹ were polymerized in sequence to high conversion, yielding tapered bottlebrush polymers that could be visualized by atomic force microscopy.

Therapeutic Depolymerizable Polymers

Methods of H₂S Delivery
H₂S is a vital biological signaling gas, and we aim to exploit its therapeutic potential by controlling the rate, location, and duration of its delivery. We make new small molecules, polymers, and hydrogels to accomplish this.

Self Amplifying Depolymerizable Polymers

Polysaccharide-Based Materials
Cellulose-based materials are bio-sourced and renewable but tend to be brittle. Blending them with polybutadiene can improve the flexibility of the resulting material. Addition of a compatibilizer can improve their mixing in a blend.

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