New paper describes first-ever synthesis of hyperbranched polymers

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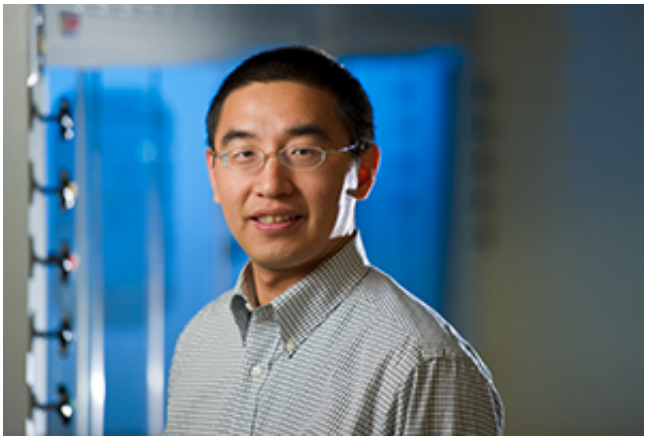

Haifeng Gao

A new paper by a team of researchers that includes Haifeng Gao, an assistant professor of chemistry and biochemistry at the University of Notre Dame, presents, for the first time, a one-pot, one-batch synthesis of hyperbranched polymers with tunablemolecular weights, uniform size and high degree of branching using an efficient click polymerization technique.

Hyperbranched polymers with tree-like nanostructures and multiple chain-end functionalities represent an important type of soft nanomaterials that can be used in a variety of applications, ranging from specialty additives, nanomedicines and catalysis.

"However, robust synthetic methods that can easily control the polymer structures, molecular weights and uniformity have not been reported," Gao said. Specifically, the copper-catalyzed azide-alkyne cycloaddition polymerization of an AB2 trifunctional monomer demonstrates a desirable 'living' chain-growth mechanism with increased molecular weight versus conversion and clean chain extension in repeated monomer additions. In addition, the reaction of monomer in polymerization showed accelerated reaction of the two B groups, producing hyperbranched polymers with high degree of branching (DB) = 0.83."

The current challenge on the synthesis of hyperbranched polymers is the lack of structural control in the polymer product, which significantly limits their potential applications.

"Development of facile synthetic techniques that can routinely produce structurally defined hyperbranched polymers in large quantities with low cost will definitely stimulate interest and feasibility to explore the materials' properties in these applications," Gao said.

"We are going to investigate the polymerization mechanism in this rationally designed system and explore numerous variables to produce a library of hyperbranched polymers with tunable molecular weights, compositions and microstructures.

"These polymers after decoration and functionalization can demonstrate intriguing properties and will be explored for applications in nanomedicines and polymer catalysis," Gao said.

Gao's research focuses on the interdisciplinary field between polymer chemistry and materials science, targeting new methodologies to synthesize functional polymers with controlled nanostructures and subsequently to discover and exploit their novel physical properties.

"This paper represents our recent research achievement on developing facile techniques to produce structurally defined hyperbranched polymers," he said.

More information: "Inside Cover: Chain-Growth Click Polymerization of AB2 Monomers for the Formation of Hyperbranched Polymers with Low Polydispersities in a One-Pot Process." (*Angew. Chem. Int. Ed*. 26/2015). *Angew. Chem. Int. Ed*., 54: 7454. doi: 10.1002/anie.201504792

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