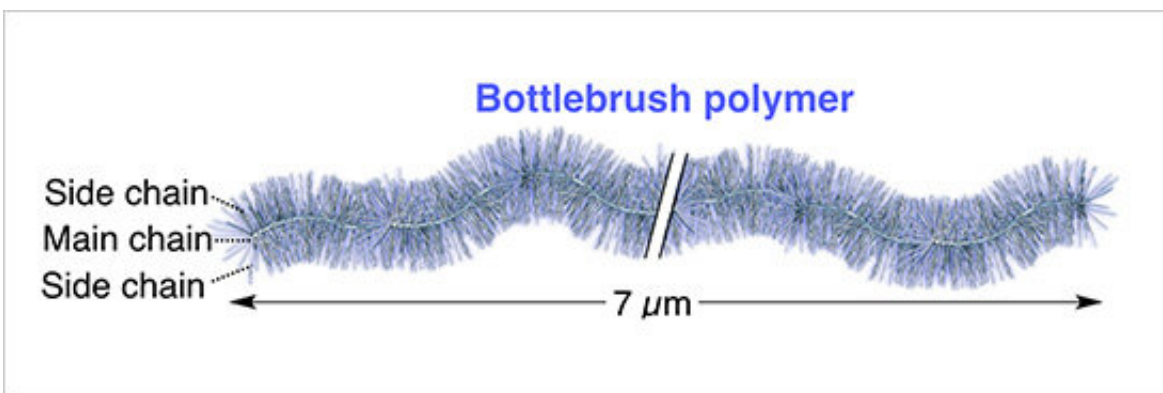


# The world's longest bottlebrush polymer ever synthesized

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Bottlebrush polymer is a polymer consisting of a single main chain and numerous side chains grafting from the main chain. Credit: National Institute for Materials Science

NIMS and RIKEN have succeeded in synthesizing the longest ever bottlebrush polymer. This polymer—resembling a green foxtail—is composed of a main chain and numerous side chains grafting from it. The team also succeeded in giving various chemical properties to the ultralong bottlebrush polymer. These achievements are expected to substantially advance the current synthetic methods of bottlebrush polymers. This technique may be applicable to the development of flexible and low-friction polymeric materials.

In the development of polymeric materials, it is necessary to link molecular units with desired chemical properties, called monomers, to

the desired length. In this context, bottlebrush polymers are attracting attention as a new type of [polymer](#) material, consisting of a single main chain and numerous side chains, and it is possible to design polymers with various [chemical](#) compositions by selecting the side chains. On the other hand, conventional synthetic methods are limited to lengths on the order of several hundred nanometers, or at most about 1  $\mu\text{m}$ , due to issues such as monomer reactivity and the presence of trace impurities, and there is no precedent for the synthesis of bottlebrush polymers longer than 2  $\mu\text{m}$ .

This research team recently succeeded in synthesizing the longest bottlebrush polymer ever by devising the molecular design of the monomer as starting material and using a single crystal of the [monomer](#) to set up a polymerization environment with very few impurities. The length reached 7  $\mu\text{m}$ , which is about 3.8 times longer than the longest value so far. Furthermore, by combining two types of polymerization methods, the research team succeeded in synthesizing bottlebrush polymers with four types of side chains while maintaining the length of the main chain.

Use of the monomers developed in this research enables the synthesis of a variety of bottlebrush polymers with controlled length, diameter and [chemical properties](#). Bottlebrush polymers may be used as a low-friction surface coating. Applying this polymer to the surfaces of moving machinery parts, for example, may reduce energy loss caused by friction. In future studies, we plan to develop flexible and low-friction materials taking advantage of the ultralong bottlebrush polymer.

**More information:** Yoshihiro Yamauchi et al, Two-Step Divergent Synthesis of Monodisperse and Ultra-Long Bottlebrush Polymers from an Easily Purifiable ROMP Monomer, *Angewandte Chemie International Edition* (2020). [DOI: 10.1002/anie.202009759](https://doi.org/10.1002/anie.202009759)

Provided by National Institute for Materials Science

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