Bottle-brush design enhances cellular imaging

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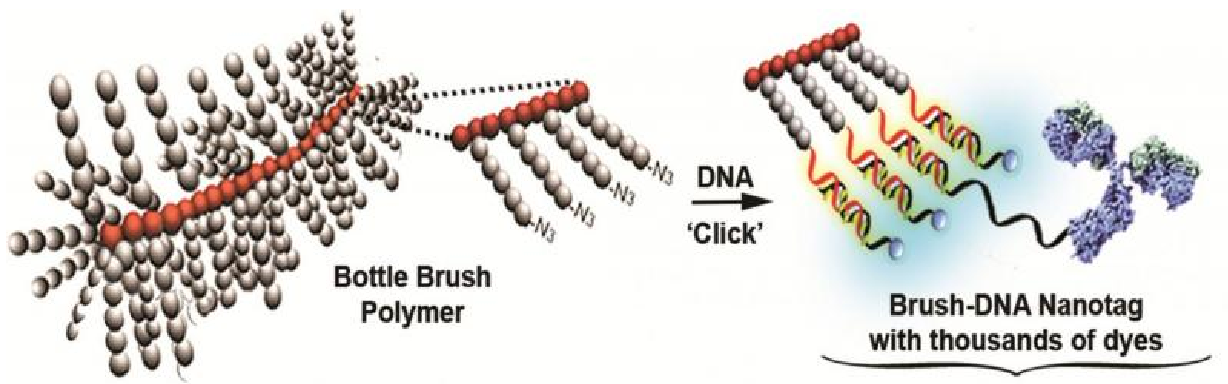

A bottle-brush polymer is modified with DNA, loaded with thousands of dye molecules and attached to an antibody to visualize cell-surface targets. Credit: American Chemical Society

The bottle brush, with its long stalk and dense spray of plastic bristles, is the unsung hero of kitchens everywhere, fitting through the narrow necks of water bottles and vases and into the hard-to-reach interiors of mugs and tumblers. With the gadget's unique design as inspiration, researchers now report in *ACS Central Science* the development of bottle-brush nanotags that can contain thousands of fluorophores, greatly enhancing the detection and analysis of cells.

Fluorescent probes help researchers see particular cells or proteins. For example, these probes are often used to distinguish healthy cells from cancerous ones. The most common approach is to make a sandwich of a "primary" antibody specific for a certain protein on a cell and a "secondary" antibody connected to fluorophores. But if a protein is expressed at a low level, it can be difficult to detect. In those cases, many fluorophores are attached to the secondary antibody to amplify the signal. However, there's a limit to that strategy—when the fluorophores are too close together, self-quenching can actually reduce the signal. To overcome this challenge, teams in the labs of Krzysztof Matyjaszewski, Bruce Armitage and Subha R. Das found inspiration in the many bristles of the bottle brush.

The groups created brush-shaped polymers with side chains that resemble bristles. From there, they attached DNA to the tips of these bristles and used complementary DNA to create a double-stranded structure. Special fluorescent molecules that bind only inside double-stranded DNA were added. The bottle-brush structure could then serve as a new type of secondary antibody that could bind to thousands of fluorophores, enhancing the signal by about 10 times compared to existing methods. The design permits the use of different dyes so that a wide range of colors of these fluorescent nanotags can be readily obtained. The authors note that, with additional tweaking, the brushes also could someday deliver cancer therapeutics.

More information: Munira F. Fouz et al. Bright Fluorescent Nanotags from Bottlebrush Polymers with DNA-Tipped Bristles, *ACS Central Science* (2015). DOI: 10.1021/acscentsci.5b00259

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