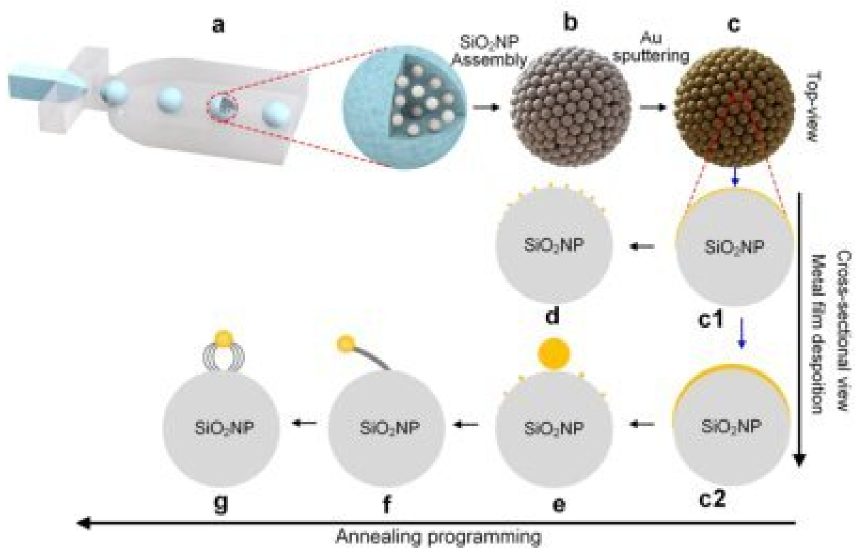
Bouquets of nanoflowers with a golden touch

March 10 2020



Credit: University of Twente

Using nano-sized spheres as a starting point, researcher Juan Wang of the University of Twente (MESA+ Institute) creates fascinating structures that can have a wide range of shapes and functionalities. They can even achieve a beautiful flower-like appearance with nanowires connected by gold nanospheres. The new nanostructures can be designed for detecting chemical or biological substances at their surface. They have unique optical properties and can also mimic a biological surface that attracts or repels water.

Building with nanospheres makes it possible to add functionality step by step. The simplest starting point is a sphere made of silica glass a few hundred nanometers in size, while the end result can be a of a sphere coated with tiny gold spheres or a with nanowires sticking out, resembling the sphere-shaped allium flower. By combining spheres and creating a 'wrinkly' surface, a bio-inspired surface is possible that has the sticky characteristics of a rose petal, or the water-repellent behavior of a lotus leaf instead.

Color code

Wang describes other powerful combinations. As the spheres can act as photonic crystals, reflecting a specific color of light, in combination, they can form a color 'watermark' that can't be copied. In materials analysis, the technique of surface plasmon resonance (SPR) is often used in combination with gold surfaces—that's why gold-covered spheres are so interesting. SPR works by shining light on the surface for activating electrons: Locally, the reflected light gives information about the substance on top of the gold. Combining SPR with the photonic crystal behavior may even lead to materials analysis using a simple color scan in which the color shift can be used as an indication of the binded substances, for example, in diagnostics.

The flower-like spheres connected by the silica nanowires are gold on top, and have special wetting properties. They can be used for manipulating fluids, for example, in separating oil and water, or as a basic component in microreactors.

Bottom-up nanofabrication

Wang's approach of nano-manufacturing is typically bottom-up: She starts with a basic component and adds functionality by adding new particles with different length scales. In most nanomanufacturing techniques, the structures are formed by removing material by etching, adding a new layer, again etching patterns in the new layer, and so on. The new, bio-inspired approach adds a powerful platform to fields like microfluidics, photonics and materials engineering.

More information: Juan Wang (1991, Baoji, China) did her research in the BIOS Lab-on-a-Chip Group, part of UT's MESA+ Institute, and at the South China Academy of Advanced Optoelectronics (South China Normal University, Guangzhou). She defended her PhD thesis on March 6. The title is '3D Hierarchical Particle Assemblies with Nanostructure-Enabled Functionalities'.

Provided by University of Twente

Citation: Bouquets of nanoflowers with a golden touch (2020, March 10) retrieved 27 April 2024 from https://phys.org/news/2020-03-bouquets-nanoflowers-golden.html