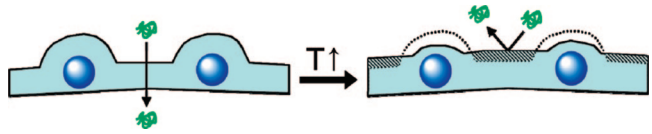
Magic Shell? Using Gold Nanoparticles on Polymeric Microcontainers

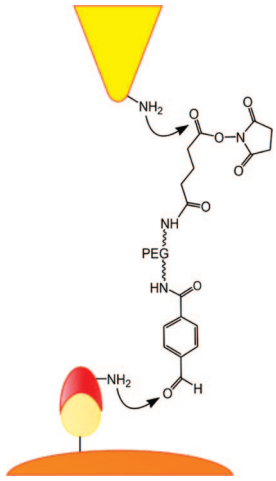
The development of microcapsules that can be triggered remotely to release their contents is an intriguing concept for drug delivery. However, fabrication of capsules that retain the properties of the load material during release without harming living tissues has remained challenging. Some researchers have suggested using polymeric microshells functionalized with nanoparticles because laser-induced release can be stimulated with light absorption in the near-infrared range where damage to tissue is minimized.

Testing this concept, Bédard *et al.* (p 1807) developed polymeric shells that incorporated gold nanoparticles that were either uniformly distributed or aggregated within the microcapsule. The researchers found that microcapsules with aggregated gold nanoparticles required significantly



more energy than those with uniform nanoparticle distribution to shrink thermally, a process that reorganizes loosely arranged polyelectrolyte layers into denser structures. Thermally shrunk microcapsules containing aggregated nanoparticles were also more permeable than their uniformly distributed counterparts. When the scientists tested capsule release upon near-infrared laser stimulation, they found that the aggregated gold microcapsules required less energy to open than the uniformly distributed ones. Microcapsules formulated without nanoparticles did not release their contents with near-infrared laser stimulation. The authors suggest that the aggregates lead to local hot spots, explaining these differences in behavior between the types of capsules. They note that their findings could have implications for other temperature- and light-sensitive materials and methods, such as intracellular delivery, membranes, nanoparticle delivery, and anticorrosion protection.

Sugar Coated: Investigating Polysaccharide Molecules on Live Bacteria



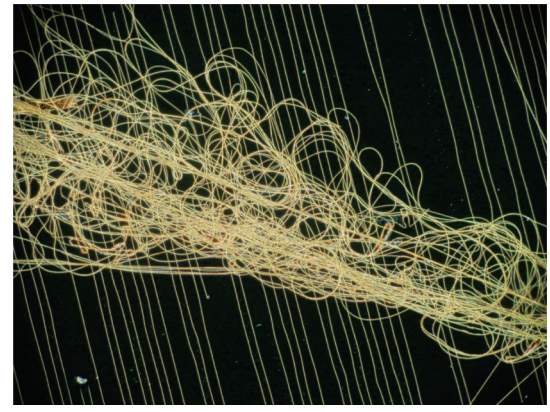
Many species of bacteria produce polysaccharides on their cell surfaces. These sugars have been linked to a variety of activities that can affect human health, such as biofilm formation and a strong adhesive capacity to epithelial cells. However, little is known about the mechanism behind these activities, including whether the quantities of polysaccharides and/or the percentages of different types of these sugars play roles.

Taking a step toward answering these questions, Francius *et al.* (p 1921) used single-molecule force spectroscopy (SMFS), a modified form of atomic force microscopy (AFM), to locate, to quantify, and to analyze polysaccharide molecules on the surfaces of live bacteria. In an initial AFM scan, the researchers examined the surfaces of a clinically important probiotic bacterium, *Lactobacillus rhamnosus* GG (LGG), and a mutant strain known to have impaired adherence to gut epithelium, biofilm formation, and exopolysaccharide production. The scan showed that the surface of LGG was covered with deep waves, suggesting high production of extracellular polysaccharides, but the surface of the mutant strain was significantly smoother. Then, using SFMS with lectin-modified tips to examine molecules on the strains' surfaces, the team found that the two strains showed very different polysaccharide properties, with LGG having a much higher surface density and extension of mannose- and galactose-rich polysaccharides than the mutant. The authors suggest that this method could be used in future studies to investigate how polysaccharides on other bacterial types vary and to understand how these variations affect human health.

An Electrifying New Method for Fabricating Nanowires

Metal nanowires have been used in numerous nanotechnology applications including as sensors and as optical and electronic device elements. For many of these applications, long (>10 μm), narrow (<50 m) metal nanowires are desirable; however, current fabrication methods, including electron beam lithography, are limited to the fabrication of shorter nanowire segments due to the labor-intensive nature or the resolution of the method. Consequently, researchers have focused on developing effective facile methods for creating ever-lengthening nanowires, especially in patterns to enable these wires to serve as functional interconnects, circuit elements, or optical transducers.

Combining the resolution of lithography with the speed and cost benefits of electrodeposition, Xiang *et al.* (p 1939) showcase a novel method that they call lithographically patterned nanowire electrodeposition (LPNE), which involves fabricating by photolithography a temporary, sacrificial template composed of photoresist and a metal film on a glass surface. Trenches of a desired pattern are etched in this surface, and metal nanowires are electrodeposited within, displayed openly once the photoresist and metal film are removed. This method generates nanowires of controllable height and width with total lengths of up to 1 cm. Using LPNE, the researchers generated nanowires made of gold, palladium, and bismuth. They demonstrated that these wires show a temperature-dependent resistivity consistent with their known lateral dimensions and grain diameters. The scientists also show that this method is capable of patterning a square centimeter with a grid of linear metal nanowires with a pitch of 2 μm within 5−6 h, a task that would take significantly longer with conventional lithographic methods. The authors suggest that this approach could be compatible with a wide variety of other metals.



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