Bacteria found in desert pave the way for paint that produces oxygen while capturing carbon

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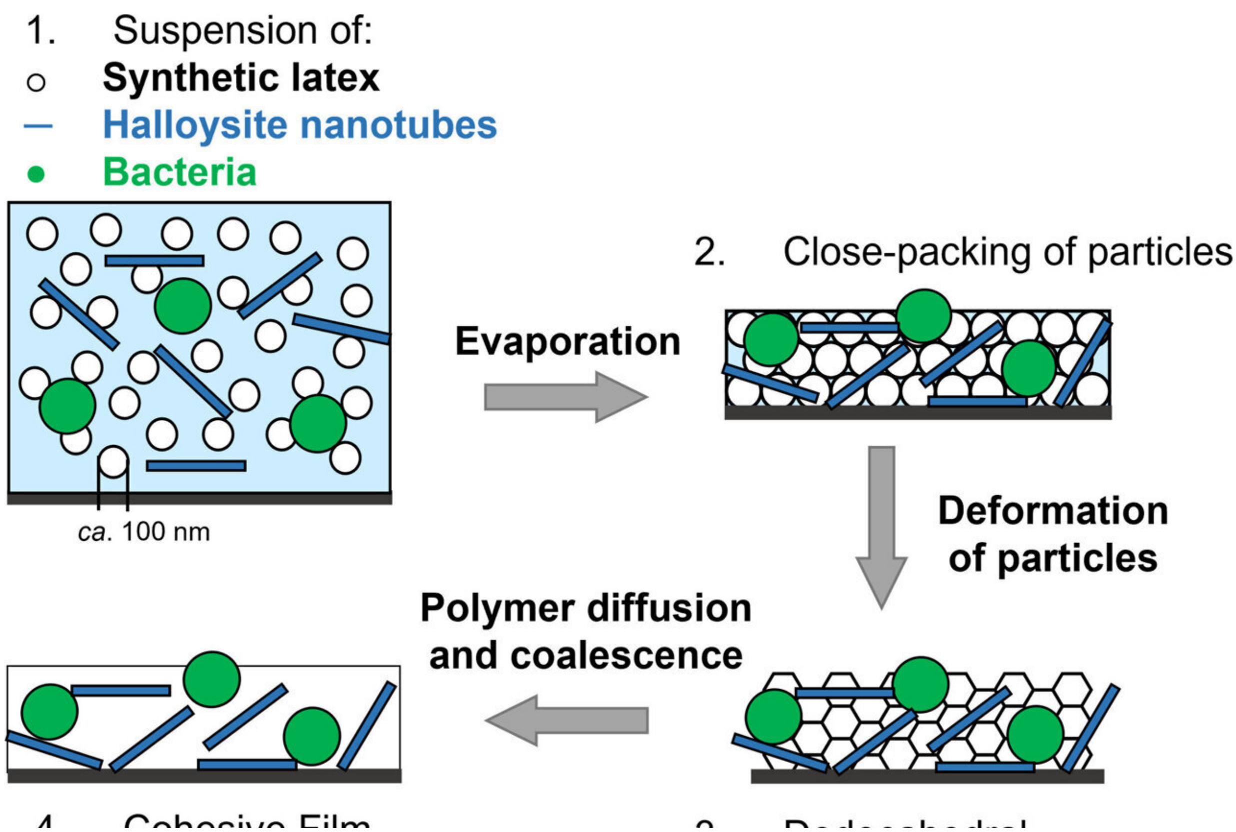

The film formation process of the biocoating formulation, consisting of four steps. (1) The aqueous biocoating mixture, containing latex and bacteria, is deposited on a substrate. (2) The evaporation of the water takes place and the particles become closely packed (ideally in a face-centered cubic structure). (3) The particles deform to fill space and adopt a rhombic dodecahedral structure, which results in optical clarity of the coating. (4) The polymer molecules diffuse across the particle boundaries, and the particles coalesce when at a temperature above the glass transition temperature (T_g). A cohesive film results. (Diagram not drawn to scale.). Credit: *Microbiology Spectrum* (2023). DOI: 10.1128/spectrum.01870-23

An innovative paint that contains oxygen-producing bacteria capable of capturing carbon dioxide (CO_2) has been created by scientists from the University of Surrey. Researchers suggest this paint, known as a "biocoating," could be used in extreme environments, such as space stations. This study was published in the journal *Microbiology Spectrum*.

Biocoatings are a type of water-based paint that encase live bacteria within layers. Besides capturing carbon, they can also serve as bioreactors or as biosensors.

Surrey's creation, named "Green Living Paint," features Chroococcidiopsis cubana, a bacterium that undergoes photosynthesis to produce oxygen while capturing CO_2. This species is usually found in the desert and requires little water for survival. Classified as an extremophile, it can survive these extreme conditions.

Dr. Suzie Hingley-Wilson, a senior lecturer in bacteriology at the University of Surrey said, "With the increase in greenhouse gases, particularly CO_2, in the atmosphere and concerns about water shortages due to rising global temperatures, we need innovative, environmentally friendly, and sustainable materials. Mechanically robust, ready-to-use biocoatings, or 'living paints,' could help meet these challenges by reducing water consumption in typically water-intensive bioreactor-based processes."

To investigate the suitability of Chroococcidiopsis cubana as a biocoating, researchers immobilized the bacteria in a mechanically robust biocoating made from polymer particles and natural clay nanotubes in water, which was fully dried before rehydrating. They observed that the bacteria within the biocoating produced up to 0.4 g of oxygen per gram of biomass per day and captured CO_2. Continuous measurements of oxygen showed no signs of decreasing activity over a month.

In contrast, researchers conducted similar experiments with the bacterium Synechocystis sp., another cyanobacterium usually found in freshwater. Unlike its desert counterpart, it was unable to produce oxygen within the biocoating.

Simone Krings, the lead author and a former Postgraduate Researcher in the Department of Microbial Sciences at the University of Surrey, said, "The photosynthetic Chroococcidiopsis have an extraordinary ability to survive in extreme environments, like droughts and after high levels of UV radiation exposure. This makes them potential candidates for Mars colonization."

More information: Simone Krings et al, Oxygen evolution from extremophilic cyanobacteria confined in hard biocoatings, *Microbiology Spectrum* (2023). DOI: 10.1128/spectrum.01870-23

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