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Nanoscale Taste Buds for Monitoring Drinking Water Treatment Sites in Island Communities

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Abstract

Water treatment sites commonly operate a "sample and test" process to monitor the health of their system via off-site laboratory analysis. This provides a snapshot of the system at the time of sampling, which, for decentralised treatment sites, can mean a significant delay between system failure and detection. This is a problem which is further magnified in island communities, where transport of samples to centralised laboratory facilities may be particularly challenging. As a result, there is a need for a cheap, fast, simple technology that can be located in island treatment sites to provide real-time water monitoring, and to alert of system failures before water supplies are compromised.

We present an artificial taste bud sensor designed as a real-time monitoring device for remote drinking water treatment sites. The sensor is comprised of millions of nano-scale metal structures (each 1000x smaller than the width of a human hair, at approx. 100nm in size). Made of gold, these nano-structures exhibit structural colour; colour that is a product of their geometry and their environmental surroundings. If their surroundings change (from "clean" water to "dirty" water, for instance) then their colour will change.

Our sensor contains many of these coloured regions, each modified with a different chemical group. The chemical modifications give us functionality that is analogous to the human perception of taste, allowing us to record a response that is unique to each water sample's molecular composition.

Using machine learning, the sensor can be trained to recognise when the composition of a water supply is drifting away from acceptable norms, indicating a problem with the treatment system.

The low-power, real-time nature of our new nano-scale technology, along with its ability to detect small changes in water composition, makes it a good candidate as a future, on-site monitoring tool for island-based water treatment facilities.

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