Detecting silver nanoparticles for our safety

By Yun Xie | Published 2 years ago

You may not be aware of it, but silver nanoparticles are cropping up in a variety of consumer products, including soaps, sanitizers, fabric softeners, detergents, cosmetics, and wound dressings. As they increase in popularity, more of them will be released into the environment through the sewer line. While silver nanoparticles are useful for their antibacterial properties, they can cause problems when they are no longer involved in their intended roles. In the environment, they could kill benign bacteria and harm living organisms by disrupting certain metabolites and enzymes.

In light of the potential risks, it is essential for scientists to be able to quickly and easily determine the presence of silver nanoparticles at possible sites of contamination, such as water reservoirs. Current methods require costly equipment and extensive methods of sample preparation. It would be far simpler to have a chemical probe specific to silver nanoparticles. Several probes exist for detecting silver cations, but none of them are designed to detect the silver in nanoparticles.

The chemical probes for silver cations work by binding to the positively charged silver and undergoing a change in its molecular structure in response, resulting in some observable difference either in color or fluorescence. The silver in nanoparticles is not cationic, so it doesn't react with the chemical sensors. A team of Korean scientists led by Kyo Han Ahn worked around this problem by using some basic chemistry.

Ahn and his colleagues used hydrogen peroxide to oxidize the silver nanoparticles, producing silver cations, and they synthesized a chemical probe that reacts with silver cations under oxidizing conditions. When the probe and hydrogen peroxide are added to a solution of silver nanoparticles, the probe changes both color (colorless to pink) and fluorescence (no fluorescence to strong orange fluorescence). The probe is selective for silver cations and has a detection limit of 14 parts-per-billion.

In addition to detecting the presence of silver nanoparticles, the probe can also report concentrations. Ahn's team calibrated the fluorescence intensity of the probe with known concentrations of silver nanoparticles. Based on the calibration, they calculated the concentrations of silver nanoparticles in a hand sanitizer gel (1.9 ppm) and fabric softener (0.6 ppm). They obtained values that were the same as the ones determined by more complicated techniques.

Ahn's probe has many possible applications. It can be used in the field to quickly find areas contaminated by silver nanopartilces, and it can be used to determine their concentrations in commercial products, which don't always specify how much they contain.

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