Researchers develop first of its kind, simple test for identifying toxic silver ions

July 15 2020

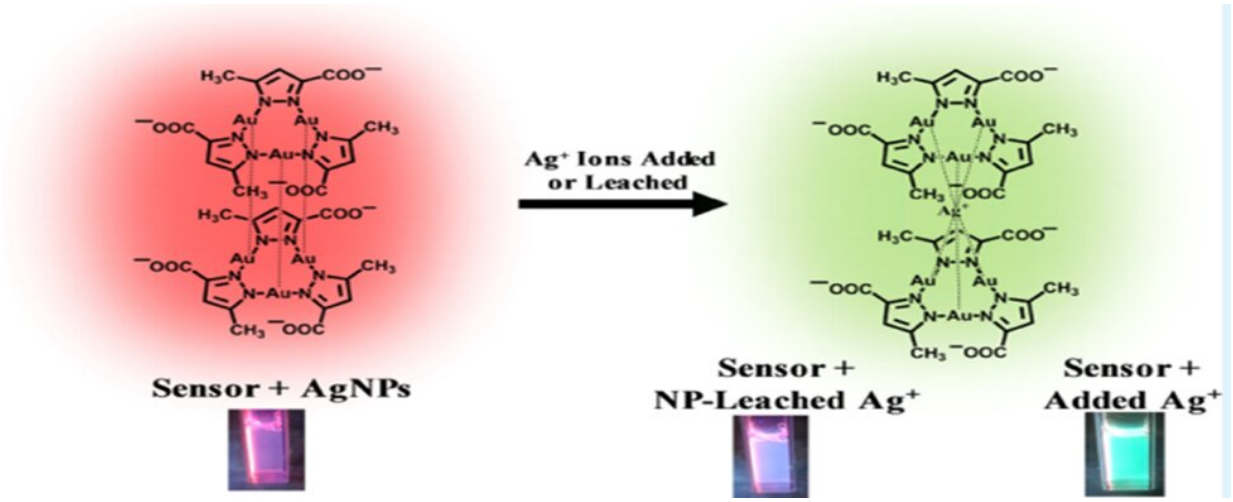

Illustration of test results showing silver ions Credit: UNT

Chemistry researchers at the University of North Texas have developed a test to more easily identify toxic silver ions, which can be harmful to humans and the environment at high concentrations.

Silver nanoparticles (AgNPs) are well known for their antimicrobial properties and can be found in a number of products such as bedding, toothpaste and toys. But, over time, silver ions can leach from AgNP products into the surrounding environment.

"Right now, scientists are studying how AgNPs move from a product into the environment," said research assistant professor Sreekar Marpu "In one instance, researchers looked into various types of food packing containers doped with AgNPs. In the case of the containers containing acidic foods, there was a measurable movement of silver from the packaging to the food product in as little as 10 days. Where, in the form of ions, the silver is toxic."

The ability to differentiate between the presence of silver nanoparticles and silver ions is important in both determining the toxicity of a substance and also discovering the time it takes silver ions to leach from nanoparticles in various products, knowledge that could have a huge impact on the environment.

While there are tests to determine if there is silver in a substance, there is no quick and easy way to determine if it is the ion or nanoparticle form, and sensitivity below the order of part-per-million (sub-ppm) has been lacking.

The patent-pending test created by Marpu and Professor Mohammad A. Omary, both in UNT's College of Science, will be able to tell the difference at sub-ppm levels.

"Certain gold(I)-based macrocyclic molecular systems can interact with silver ions (Ag^+) and can be used as sensors," Marpu said. "We use a phosphorescent gold(I) complex that not only attracts silver ions selectively versus nanoparticles but also only changes its emission color based on which is present (bright green with $Ag^+$and faint red with AgNPs,)" Marpu and Omary said.

When exposed to ultraviolet light, the silver ion-attracting gold(I) complex will emit red color on its own or when in the presence of silver NPs. Over time, as the silver NPs break down and silver ions are

released, the red color will shift toward bright green. To better understand the chemical processes involved, Marpu set up a month-long experiment to observe the change.

"We monitored the leaching of silver ions from nanoparticles over a period of 35 days and watched the color change from red to green as the ratios changed," Marpu said. "I believe this is the only ratiometric luminescence-based silver sensor to successfully differentiate between the ions and the nanoparticles."

More information: Erin N. Benton et al. Ratiometric Phosphorescent Silver Sensor: Detection and Quantification of Free Silver Ions within Silver Nanoparticles, *ACS Applied Materials & Interfaces* (2019). DOI: 10.1021/acsami.9b01224

Provided by University of North Texas