Researchers create plasmonic paper for detecting chemicals and biologically important molecules

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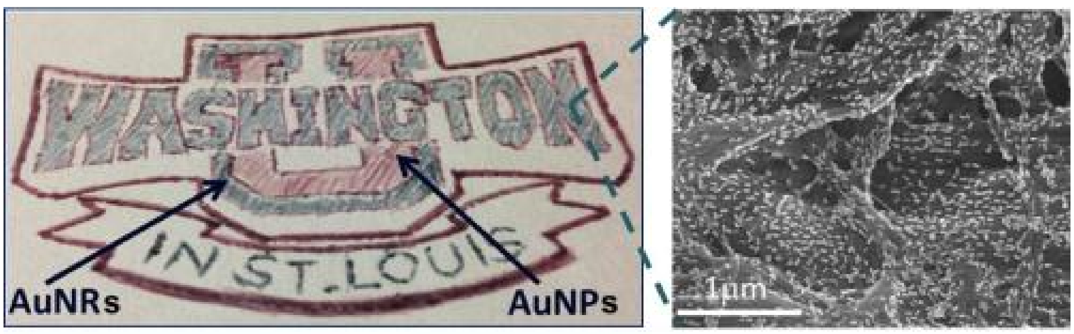

A hand drawing of Washington University logo using gold nanorods (AuNRs) and gold nanospheres (AuNPs) as plasmonic ink, in which red and green colors result from the inherent optical properties of nanopaticles (Right: A representative scanning electron microscopy image of gold nanorods on paper). Credit: L.Tian/WU

Using a common laboratory filter paper decorated with gold nanoparticles, researchers at Washington University in St. Louis have created a unique platform, known as "plasmonic paper," for detecting and characterizing even trace amounts of chemicals and biologically important molecules—from explosives, chemical warfare agents and environmental pollutants to disease markers.

The work will be described by Srikanth Singamaneni, assistant professor in the department of mechanical engineering and materials science at Washington University in St. Louis, and postdoc Limei Tian at the AVS 61th International Symposium and Exhibition, held Nov. 9-14, at the Baltimore Convention Center in Baltimore, Maryland.

Plasmonics involves the control of light at the nanoscale using surface plasmons, which are coordinated waves, or ripples, of electrons that exist on the surfaces of materials, and in particular metals such as gold. Localized surface plasmons of metal nanostructures result in unique optical properties with characteristics that depend upon the metal composition, size and shape of structures, the surrounding medium, and so on.

Tian and Singamaneni created their plasmonic paper by immersing common cellulosic filter paper into a solution of gold nanoparticles. Such a simple optically active platform can be employed to enhance the fingerprint signal of chemicals, revealing the identity of a trace amount of a compound such as a chemical warfare agent. In addition clinically important proteins can be captured by modified plasmonic paper and detected based on changes in the optical spectra that result when the proteins bind to the paper.

"In-field detection of chemical and biological threats is the challenge that we are trying to address," Tian said. "This technology can be broadly used for chemical and biological sensing, including homeland security, forensics and environmental monitoring, and medical diagnostic applications."

For example, Tian noted, the plasmonic paper can be used to detect target molecules that serve as indicators for diseases such as kidney cancer.

"We believe that we have a platform technology that nicely lends itself for such applications," Tian said.

At the same time, Tian and Singamaneni stressed that a number of obstacles remain to be overcome before the technology can be used for chemical detection applications, not the least of which is the complexity of the "chemical space" in the real world. Because vast numbers of chemicals exist that would interfere with accurate measurements, these tests require very high selectivity—at a level that the current incarnation of plasmonic paper can't yet achieve.

"We expect this can be overcome by integrating biomimetic target recognition elements with plasmonic paper in the near future," Tian said.

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