Metallic nanoparticles help to determine the percentage of volatile compounds

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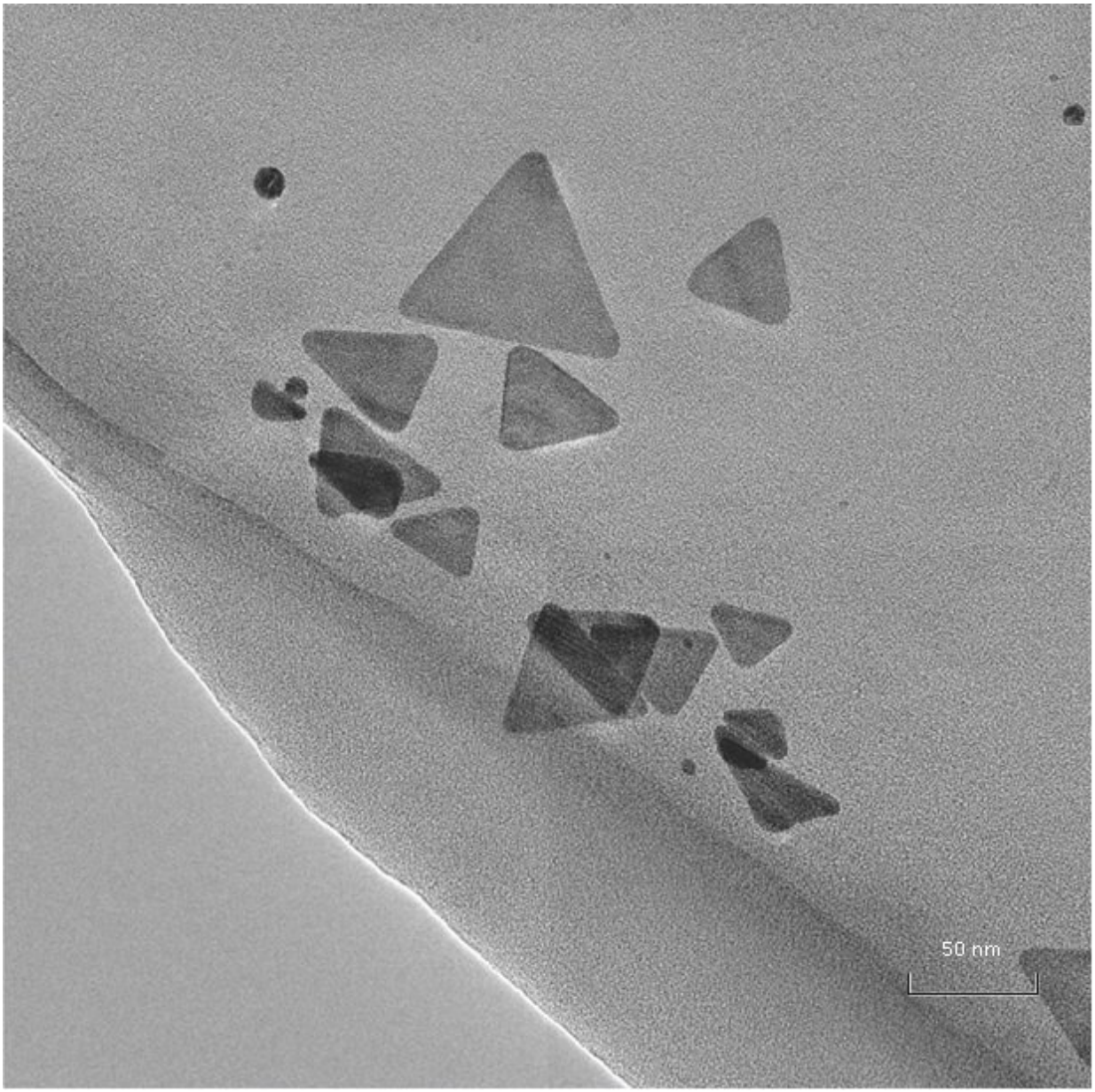

TEM micrograph of aqueous solution of silver triangular nanoplates Credit: Aleksei Furletov

Researchers from the Faculties of Chemistry and of Materials Science of Lomonosov Moscow State University have developed a new way of increasing the sensitivity of detecting volatile compounds, especially chlorine, using metallic nanoparticles. The work has been published in the *Talanta* journal.

Metallic nanoparticles, in particular the nanoparticles of gold and silver, are widely used in analytical chemistry. Among their applications are optical sensors based on the surface plasmonic resonance in colloidal solutions and on solid supports. Modern optical sensors have considerable advantages like high sensitivity, ease of detecting an analytic signal and adjustability of the optical and laboratory analysis parameters. Nevertheless, these devices have certain limitations when it comes to selectivity.

It happens because of the aggregation of nanoparticles, which happens due to high ionic strength. The ion layer formed on the surface of the particles is called the double electric layer, and is characterized by an electrokinetic potential, also known as the zeta potential. With a decrease in the zeta potential, the electrostatic stabilization of nanoparticles does not happen.

The problem can be solved if the nanoparticles are attached to solid supports; scientists then acquire micro- or nanosensors based on solid particles. There are not many matrix materials for these sensors, and the process of attaching the nanoparticles to supports is complicated, so the researchers started working toward modifying the surface of sensor matrices. For that goal, they proposed separating the nanoparticles from

ions and chemical compounds while retaining their sensitivity.

The Russian chemists invented a technique that combines optical detection using paper test strips with triangular silver nanoparticles spread over them, and dynamic gas extraction—the extraction of a compound from a solution or a dry mixture by means of liquefied gases. Viability of this technique was demonstrated by detecting chlorine. Chlorine is often used to purify water, since it destroys the outer shells of bacteria and viruses. Nevertheless, the problem of determining the chlorine concentration in water remains relevant, since the existing techniques are not sensitive enough.

Aleksei Furletov, student at Lomonosov Moscow State University, one of the paper's authors, says: "The technique allows us to determine small amounts of gaseous chlorine in the presence of large concentrations of foreign compounds without any sample preparation. This approach can be applied to other analytical systems based on metal nanoparticles, which opens up broad opportunities for the further development of this area of chemical analysis."

More information: Vladimir V. Apyari et al, Towards highly selective detection using metal nanoparticles: A case of silver triangular nanoplates and chlorine, *Talanta* (2017). DOI: 10.1016/j.talanta.2017.08.056

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