Spring 5-24-2013

Flower-shaped nanoparticles improve sensitivity of chemical detection

Vladimir Kitaev
Wilfrid Laurier University, vkitaev@wlu.ca

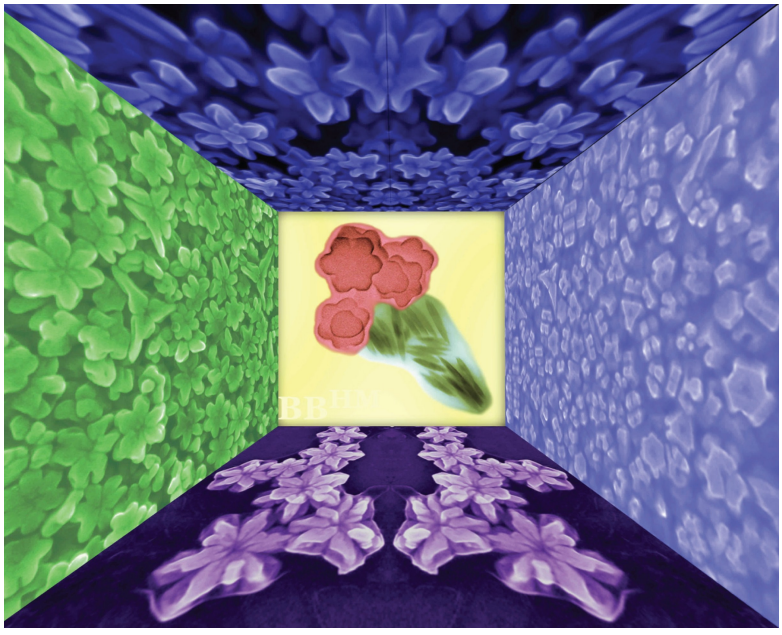
Nicole Ritter (nee Cathcart)
Wilfrid Laurier University

researchsnapshot
summarize | mobilize

Flower-shaped nanoparticles improve sensitivity of chemical detection

What did the researcher find?

Vladimir Kitaev and his team started by producing silver nanoparticles shaped as prismatic polygons in aqueous solution. These nanoparticles were less valuable for Raman spectroscopy. They then found that when large amounts of chloride ions were added during the formation, ions would freely bind to the centers of the prism edges, incompletely blocking further binding of new silver ions. This occurred everywhere except for the triangular tips of the prisms. Subsequent silver ions preferred to bind to these unprotected corners and thus "petals" grew from the corners.
These particles are flower-shaped when observed under an electron microscope. Because the nanoparticle "petals" have many well defined edges and cavities (see image), they are the best choice for increasing the sensitivity of Raman spectroscopy to unprecedented levels.
Length and definition of "petals" could be exactly controlled by varying the growing conditions. Nanoparticles with petal sizes that matched the length of the Raman laser light wavelengths were the best performers for enhancing the sensitivity of Raman spectroscopy.



What you need to know:

Raman spectroscopy can be enhanced to be more sensitive in detecting chemicals through the use of nanoparticles with sharper edges and cavities. Silver nanoparticle "flowers" developed at Laurier show the most promising results for the optimal enhancement of this diagnostic testing.

How can you use this research?

- **Medical Diagnostics tool developers** can use these nanoparticles for developing supersensitive tests for cancer, genetic and heart diseases.
- **Analytical chemists** can use these "nanoflowers" to detect very small quantities of chemicals in the environment (e.g. wastewater) or in production processes (e.g. in drug manufacturing).
- **Optics engineers** can use this research to further develop novel optical devices.

LAURIER
Inspiring Lives.

What is this research about?

Finding trace amounts of chemicals in the water and air around or inside our bodies can be accurately and quickly done using Raman spectroscopy. Raman Spectroscopy is an optical technique that involves shining a particular type of laser light onto sample (liquid or solid) and detecting the amount of reflected light with wavelengths different from the laser's original wavelength.

However, when the amount of the chemical being detected is very low, detection by Raman spectroscopy is not sensitive enough. Therefore, more expensive and labour intensive detection techniques are required.

Researchers have now found that if they combine samples with noble metal nanoparticles, especially silver, it is possible to increase the sensitivity of Raman spectroscopy and avoid more costly testing.

Pushing this technique to new limits, chemistry researchers from Laurier have developed an innovative process for "growing" unique silver nanoparticles. Nanoparticles are 100 times larger than atoms and 100,000 times smaller than an ant.

What did the researchers do?

Vladimir Kitaev, a professor of chemistry at Wilfrid Laurier University, and his research team used simple aqueous chemistry, in well-defined conditions, to grow different shapes of silver nanoparticles. These shapes included rods, several platonic solids and multifaceted prisms. Many of these faceted prisms are beautifully flower-shaped.

About the Laurier researchers:

Vladimir Kitaev is an Associate Professor with the Department of Chemistry at Wilfrid Laurier University. Nicole Ritter (neé Cathcart) is a Research Associate with Kitaev's Group.
vkitaev@wlu.ca

Article citation:

Cathcart, N., and Kitaev, V. (2012). Multifaceted prismatic silver nanoparticles: synthesis by chloride-directed selective growth from thiolate-protected clusters and SERS properties. *Nanoscale*, 4, 6981-6989.

Keywords:

Silver nanoparticles, chemical detection, Raman Spectroscopy, nanoflowers, medical diagnostics.

Cite this work:

Wilfrid Laurier University (2013). Flower-shaped silver nanoparticles improve sensitivity of spectroscopic detection of various chemicals. Retrieved at http://scholars.wlu.ca/clearlanguage

This summary is part of a project between the **Knowledge Mobilization Unit** and **Scholars Commons** at Wilfrid Laurier University, and the **Knowledge Mobilization Unit at York University.** Laurier promotes the use of knowledge mobilization to maximize the impact of Laurier research on professional practice, public policy, and community engagement. Written by O. Stukalov, S. Reibling.

www.wlu.ca/clearlanguage