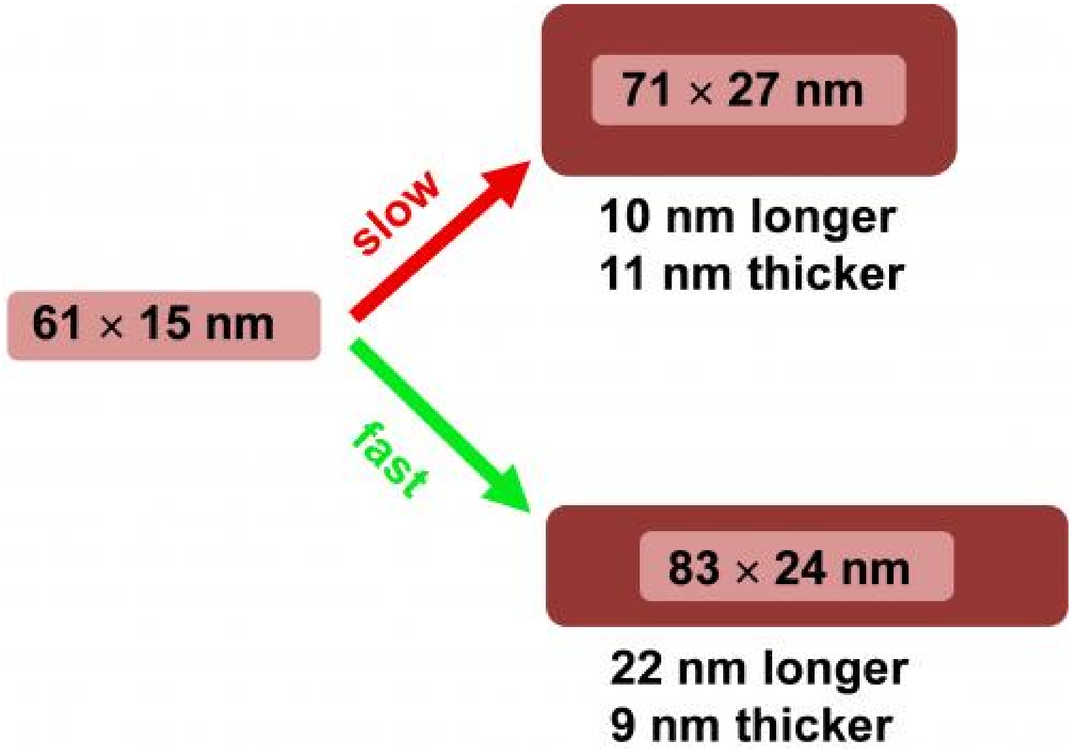
New technique controls dimensions of gold nanorods while manufacturing on a large scale

November 19 2013, by Matt Shipman



NC State University researchers found they could control the dimensions of the nanorods by varying how quickly they added ascorbic acid. Credit: Joseph Tracy, North Carolina State University

North Carolina State University researchers have a developed a technique for efficiently producing nanoscale gold rods in large quantities while simultaneously controlling the dimensions of the nanorods and their optical properties. The optical properties of gold nanorods make them desirable for use in biomedical applications ranging from imaging technologies to cancer treatment.

"This technique should facilitate the economical manufacture of large volumes of gold nanorods," says Dr. Joseph Tracy, an associate professor of materials science and engineering at NC State and senior author of a paper on the work. "And that should be good news for both the science community and the biomedical research and development community."

The NC State team started with an existing technique, in which gold nanorods are formed by mixing two chemical solutions together. However, that technique only converts 30 percent of the gold into nanorods – the rest remains dissolved in solution.

To convert the remaining 70 percent of the gold into nanorods, the researchers added a continuous stream of ascorbic acid (better known as vitamin C) to the solution, while constantly stirring the mixture. The ascorbic acid essentially pulls the gold out of the solution and deposits it on the existing nanorods.

But the researchers also found that the slower they added the ascorbic acid, the stubbier the nanorods became. This is important because the optical properties of gold nanorods depend on their "aspect ratio" – their relative height and width. For example, long, thin gold nanorods absorb light at wavelengths greater than 800 nanometers (in the near infrared spectrum), while shorter, wider gold nanorods absorb light at wavelengths below 700 nanometers (red or dark red).

"The ability to fine-tune these optical properties will likely be useful for the development of new biomedical applications," Tracy says.

More information: The paper, "Large-Scale Synthesis of Gold Nanorods through Continuous Secondary Growth," is published online in *Chemistry of Materials*. pubs.acs.org/doi/abs/10.1021/cm402277y

Abstract

Gold nanorods (GNRs) exhibit a tunable longitudinal surface plasmon resonance (LSPR) that depends on the GNR aspect ratio (AR). Independently controlling the AR and size of GNRs remains challenging but is important because the scattering intensity strongly depends on the GNR size. Here, we report a secondary (seeded) growth procedure, wherein continuous addition of ascorbic acid (AA) to a stirring solution of GNRs, stabilized by cetyltrimethylammonium bromide (CTAB) and synthesized by a common GNR growth procedure, deposits the remaining (~70%) of the Au precursor onto the GNRs. The growth phase of GNR synthesis is often performed without stirring, since stirring has been believed to reduce the yield of rod-shaped nanoparticles, but we report that stirring coupled with continuous addition of AA during secondary growth allows improved control over the AR and size of GNRs. After a common primary GNR growth procedure, the LSPR of GNRs is ~820 nm, which can be tuned between ~700-880 nm during secondary growth by adjusting the rate of AA addition or adding benzyldimethylhexadecylammonium chloride hydrate (BDAC). This approach for secondary growth can also be used with primary GNRs of different ARs to achieve different LSPRs and can likely be extended to nanoparticles of different shapes and other metals.

Provided by North Carolina State University

Citation: New technique controls dimensions of gold nanorods while manufacturing on a large scale (2013, November 19) retrieved 20 April 2024 from https://phys.org/news/2013-11-technique-dimensions-gold-nanorods-large.html