Gold Nanoparticles to Detect Arsenic in Groundwater.

Over 140 million people worldwide are exposed to dangerous amounts of arsenic in their drinking water. Long term ingestion of arsenic may lead to skin lesions, diabetes, cardiovascular decease, or skin cancer. There is a widespread need for a cheap and effective field sensor to detect arsenic in water. Can surface engineered gold nanoparticles address this need?

Gold Nanoparticles, A Versatile Tool

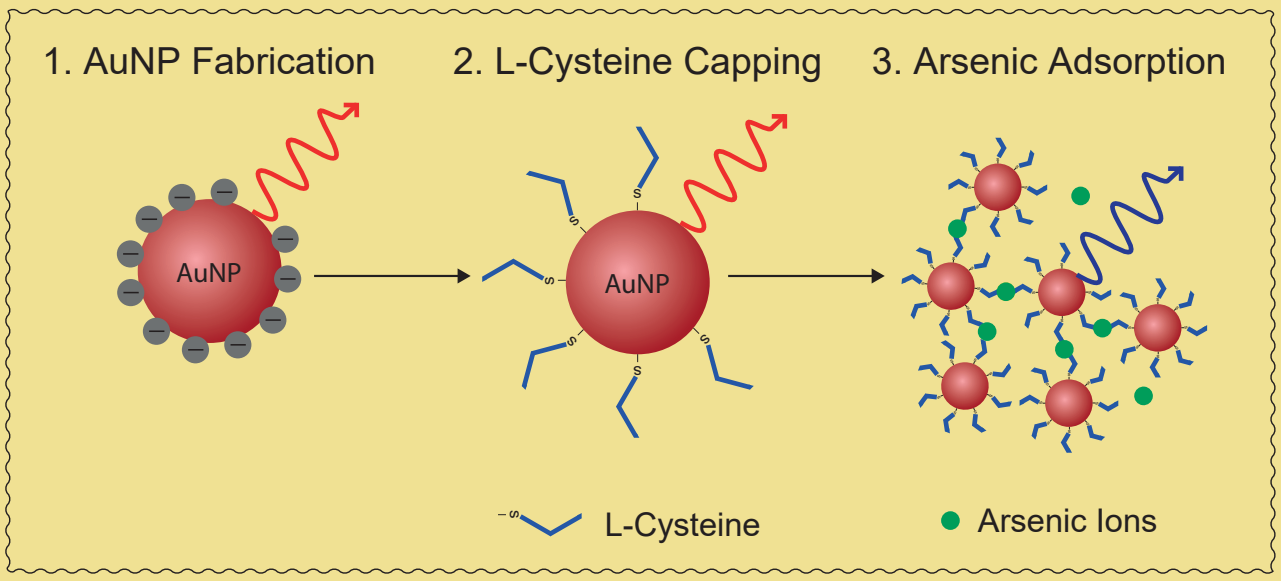
Gold nanoparticles are simply gold particles within the nanometre scale, typically ranging in between 10-100 nm. The particles have many promising properties:

1. They are inexpensive to make.
2. They are non-toxic.
3. They have a high surface to area ratio.
4. They exhibit a called surface plasmon resonance.

Surface plasmon resonance is a unique property where collective oscillations of electrons on the particle surface leads to enhanced absorption of some wavelengths of light depending on the size, shape and surrounding media of the particle.

The Method, Detecting Arsenic

The method may be split into three parts. Firstly, gold nanoparticles were fabricated using the Turkevich method, and then analysed via DLS, TEM, and ICP-AES. Secondly the particles were functionalized with L-Cysteine. And thirdly, the particles were tested, by observing the optical spectra of the particles with different concentrations of arsenic present. The three parts are expressed in the illustration below.



The Results, Bad News and Good News

The results of the experiment can be summed as follows:

- There was seemingly no difference in colour between the gold nanoparticle suspensions of the different samples.
- However, there was a measurable difference in transparency between the samples.
- A clear negative linear correlation was observed, where higher concentrations of arsenic lead to lower absorbance (higher transparency).

The arsenic testing results have therefore indicated a potential method for quantitative analysis of arsenic in groundwater down to 5 ppb, which is below the WHO provisional safety limit of 10 ppb.

An inexpensive and simple method for the fabrication of sensors was also developed during this project. The materials used were completely non-toxic and therefore the sensors created do not have any additional risks to humans and the environment.

If implemented, a gold nanoparticle based arsenic sensor could make testing the populations of many developing nations a greater opportunity for clean drinking water and better health.

However, before any implementation can be made, further research needs to be done on selectivity, sensitivity and robustness.

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