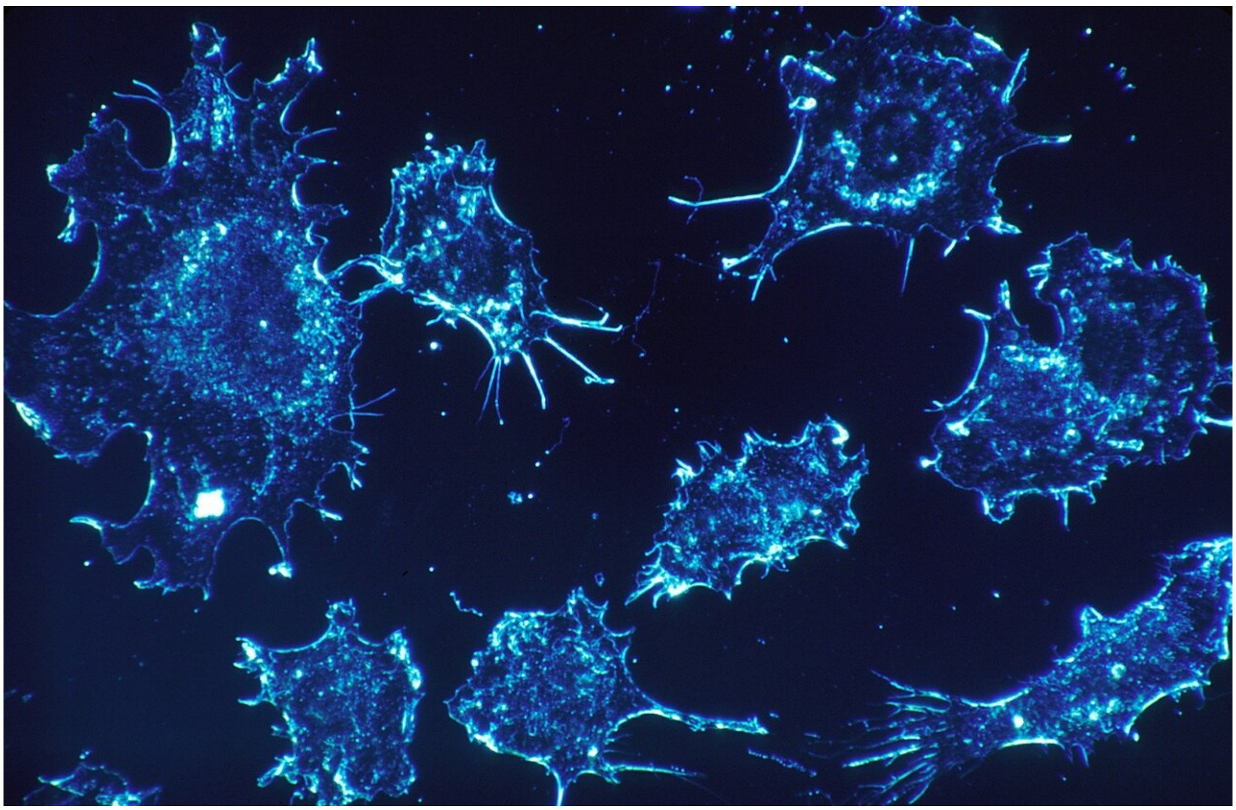
A new method to produce gold nanoparticles in cancer cells

September 11 2020



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Dipanjan Pan, professor of chemical, biochemical, and environmental engineering at UMBC, and collaborators published a seminal study in *Nature Communications* that demonstrates for the first time a method of biosynthesizing plasmonic gold nanoparticles within cancer cells, without the need for conventional bench-top lab methods. It has the potential to notably expand biomedical applications.

Conventional laboratory-based synthesis of gold nanoparticles require ionic precursors and reducing agents subjected to varying reaction conditions such as temperature, pH, and time. This leads to variation in nanoparticle size, morphology and functionalities that are directly correlated to their internalization in cells, their residence time in vivo, and clearance. In order to avoid these uncertainties, this work demonstrates that biosynthesis of gold nanoparticles can be achieved efficiently directly in human cells without requiring conventional laboratory methods.

The researchers examined how various cancer cells responded to the introduction of chloroauric acid to their cellular microenvironment by forming gold nanoparticles. These nanoparticles generated within the cell can potentially be used for various biomedical applications, including in X-ray imaging and in therapy by destroying abnormal tissue or cells.

In the paper, Pan and his team describe their new method of producing these plasmonic gold nanoparticles within cells in minutes, within a cell's nucleus, using polyethylene glycol as a delivery vector for ionic gold. "We have developed a unique system where gold nanoparticles are reduced by cellular biomolecules and those are able to retain their functionality, including the capacity to guide the remaining cluster to the nucleus," says Pan.

They also worked to further demonstrate the biomedical potential of this approach by inducing in-situ biosynthesis of gold nanoparticles within a mouse tumor, followed by photothermal remediation of the tumor. Pan explains that the mouse study exemplified how "the intracellular formation and nuclear migration of these gold nanoparticles presents a highly promising approach for drug delivery application."

"Gold is the quintessential noble element that has been used in biomedical applications since its first colloidal synthesis more than three centuries ago," Pan notes. "To appreciate its potential for clinical application, however, the most challenging research ahead of us will be to find new methods of producing these particles with uncompromised reproducibility with functionalities that can promote efficient cellular binding, clearance, and biocompatibility and to assess their long-term term effects on human health. This new study is a small but important step toward that overarching goal."

More information: Aaron S. Schwartz-Duval et al, Intratumoral generation of photothermal gold nanoparticles through a vectorized biomineralization of ionic gold, *Nature Communications* (2020). DOI: 10.1038/s41467-020-17595-6

Provided by University of Maryland Baltimore County

Citation: A new method to produce gold nanoparticles in cancer cells (2020, September 11) retrieved 18 June 2024 from https://phys.org/news/2020-09-method-gold-nanoparticles-cancer-cells.html