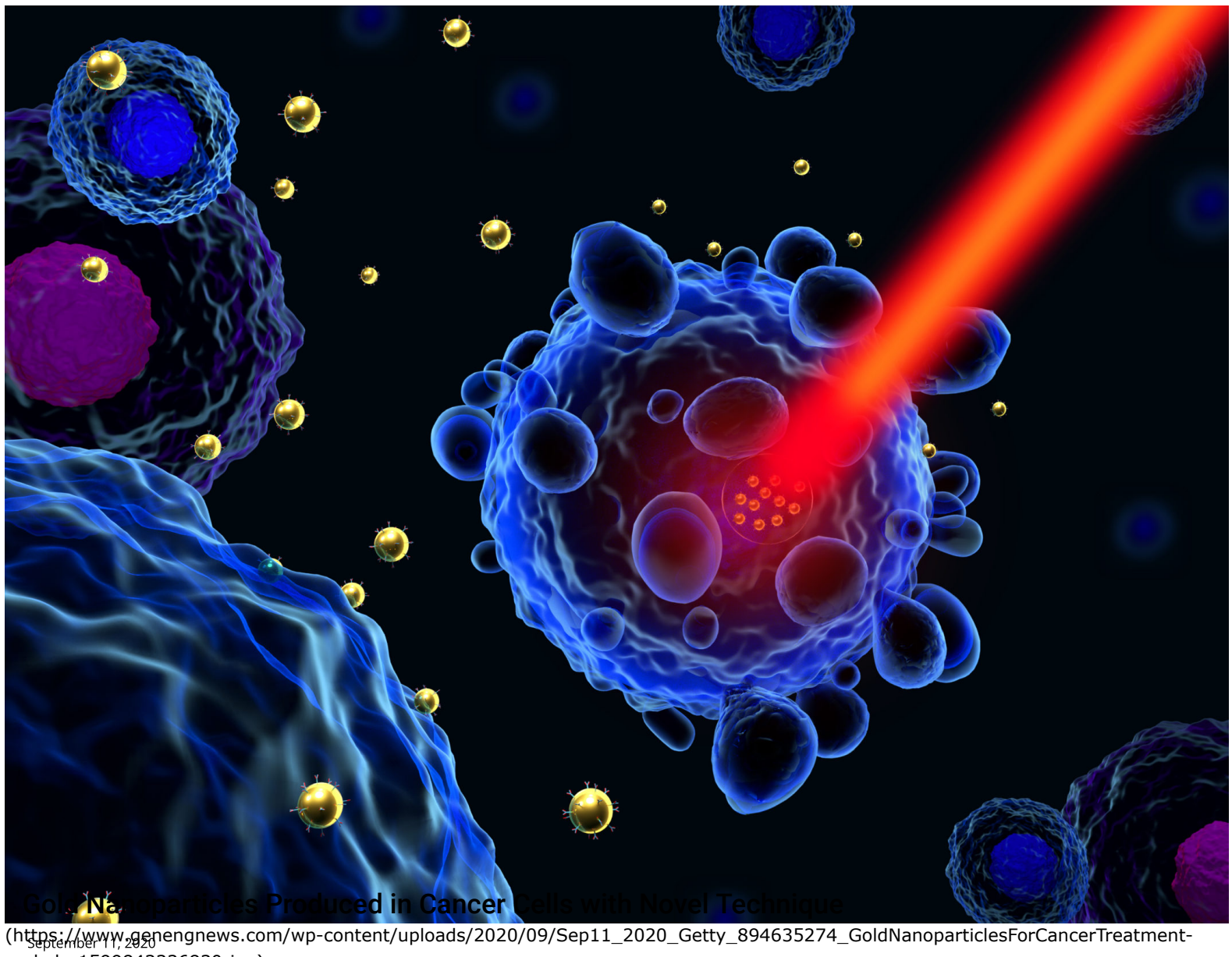

(https://www.genengnews.com/wp-content/uploads/2020/09/Sep11_2020_Getty_894635274_GoldNanoparticlesForCancerTreatment-scaled-e1599843336830.jpg)

Source: Meletios Verras/Getty Images

University of Maryland Baltimore County (UMBC) scientists and collaborators published a study, "Intratumoral generation of photothermal gold nanoparticles through a vectorized biomineralization of ionic gold (https://www.nature.com/articles/s41467-020-17595-6)," in *Nature Communications* that reportedly demonstrates for the first time a technique for biosynthesizing plasmonic gold nanoparticles within cancer cells, without the need for conventional bench-top lab methods.

The approach has the potential to notably expand biomedical applications, according to the researchers, especially in x-ray imaging and cancer therapy.

Conventional laboratory-based synthesis of gold nanoparticles requires 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.

To avoid these uncertainties, the research paper demonstrates that biosynthesis of gold nanoparticles can be achieved efficiently and directly inside cancer cells without requiring conventional laboratory methods, notes Dipanjan Pan, PhD, professor of chemical, biochemical, and environmental engineering at UMBC.

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.

"Various cancer cells have been demonstrated to have the capacity to form plasmonic gold nanoparticles when chloroauric acid is introduced to their cellular microenvironment. But their biomedical applications are limited, particularly considering the millimolar concentrations and longer incubation period of ionic gold," write the investigators.

"Here, we describe a simplistic method of intracellular biomineralization to produce plasmonic gold nanoparticles at micromolar concentrations within 30 min of application utilizing polyethylene glycol as delivery vector for ionic gold. We have characterized this process for intracellular gold nanoparticle formation, which progressively

accumulates proteins as the ionic gold clusters migrate to the nucleus. This nano-vectorized application of ionic gold emphasizes its potential biomedical opportunities while reducing the quantity of ionic gold and required incubation time."

"To demonstrate its biomedical potential, we further induce in-situ biosynthesis of gold nanoparticles within MCF7 tumor mouse xenografts which is followed by its photothermal remediation."

"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," explains Pan.

The team 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. According to Pan, the mouse study exemplifies how "the intracellular formation and nuclear migration of these gold nanoparticles presents a highly promising approach for drug delivery application."

He calls gold the quintessential noble element that has been used in biomedical applications since its first colloidal synthesis more than three centuries ago.

"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," he continues. "This new study is a small but important step toward that overarching goal."