Scientists find new way to use silicon nanoparticles in fight against cancer

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Russian scientists from Lebedev Physical Institute of the Russian Academy of Sciences, National Research Nuclear University MEPhI, G.G. Devyatykh Institute of Chemistry of High-Purity Substances of the Russian Academy, together with their European colleagues, have come up with a unique way of using silicon nanoparticles for oncological diagnostics.

When coated with a special type of polymer, such as polyethylene glycol, silicon nanoparticles can be injected into a patient. There, they freely circulate through the bloodstream, accumulating in a potential tumor, sometimes with the help of special subcellular organ-selective "address molecules," which similarly accumulate around the cancerous area.

After latching onto their target, the nanoparticles can then be detected from outside the body optically, for example, by using fluorescent light. They can also be equipped to transport medicines such as radionuclides to the affected area to eliminate the tumorous growth. The particles are safe, thanks to their compatibility with the human immune system and ability to biodegrade inside the body once their mission is complete.

However, the existing detection methods are not perfect, as they are difficult to locate when lodged in tissue, for example. Now, Dr. Andrei Kabashin, scientific director of the Institute of Engineering Physics for Biomedicine at the MEPhI National Research Nuclear University, says he and his international collaborators have come up with a unique solution to the imaging problem.

"Such nanoparticles can have a powerful nonlinear response under optical excitation, specifically through the simultaneous generation of frequency doubling, as well as two-photon tumescence. The generation of signals caused by these two effects is directly proportional to the size of the silicon nanoparticles," Dr. Kabashin explained.

Put another way, when acted upon using the newly developed tools, the frequency-sensitive nanoparticles can be spotted in their hiding places within a patient's tissue, and precisely mapped in three dimensions. According to Dr. Kabashin, the new detection method makes it possible for scientists to "reconsider the problem of bio-imaging for one of the most promising nanomaterials." Pending further study, this innovative new method could aid the existing therapeutic functionality of silicon nanoparticles in the fight against cancer.

More information: Alexander Yu. Kharin et al. Bi-Modal Nonlinear Optical Contrast from Si Nanoparticles for Cancer Theranostics, *Advanced Optical Materials* (2019). DOI: 10.1002/adom.201801728

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