Nanodiamonds: A cancer patient's best friend?

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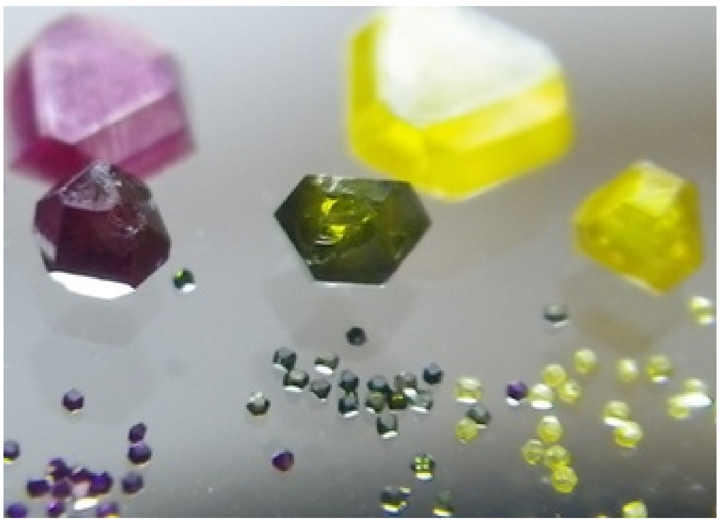

Diamonds are sometimes considered as a girl's best friend. Now, this expression is about to have a new meaning. Indeed, nanometric scale diamond particles could offer a new way to detect cancer far earlier than previously thought. This is precisely the objective of a research project called Dinamo, funded by the EU. Specifically, it aims to develop a non-invasive nanotechnology sensing platform for real-time monitoring of biomolecular processes in living cancer cells.

To do so, they developed a new technique, based on the use of fluorescent nanodiamond particles (NDPs). "We demonstrated that the specific combination of NDP-properties make them a highly suitable material for the construction of probes capable of sensing biomolecules ranging from proteins to DNA," says team coordinator Milos Nesladek, who is also principle scientist at the Institute for Material Research, Imec, based in Leuven, Belgium, "such probes could be used to study molecular processes in cells at nanoscale."

The trouble is that previous solutions did not allow monitoring processes within living cells for any extended period of time. "Our key challenge was to replace fluorescent bimolecular dyes that are currently used as luminescence markers in cancer cell research," explains Nesladek.

NDPs present several advantages. They are highly biocompatible. They can remain for prolonged periods inside cells without influencing any cellular mechanisms. Furthermore, they can be engineered to obtain a range of optic, magnetic and surface properties. "The small size of NDPs enables them to penetrate individual cell membranes in a non-invasive way, which causes no damage to the cell and without any disruption of normal cellular functions," Nesladek tells CommNet. "The luminescence and the magnetic properties change depending on the NDP's interaction with the cellular environment," he adds.

The surface properties of NDPs are such that it is possible to attach specific biomolecules to them, such as primary DNA molecules. Delivered precisely to the target cell, these biomolecules can measure, monitor or alter biological components within the cell. The NDPs can thus become not only a tool to monitor and detect pre-cancerous changes, but also to rectify them. Further developments are going on in subsequent EU-projects such as DIAMANT.

Some experts welcome this approach. "Development of new drug delivery carriers is crucial for treatment of numerous deceases, including cancer," comments Fedor Jelezko, director of the Institute of Quantum

Optics at Ulm University in Germany. "The novelty of approach in [the project] is the use of innovative material to transport drugs," he tells CommNet. Nanodiamond provides unique opportunities for drug carrier design since they can be imaged optically using fluorescence microscopy technique. "This allows monitoring of drug delivery and release of drugs in the cells with unprecedented details," he adds. This monitoring has already been demonstrated by teams of the Ecole Normale Supérieure (ENS) in Cachan and Gustave Roussy Cancer Institute in Paris, France.

Other experts are more cautious. "Although there have been numerous convincing experiments showing that nanodiamonds can carry active anti-cancer drugs in culture cells and even in mice, it is very unlikely that it will be ever used in humans, mostly because diamond is so inert that it cannot be degraded and therefore cannot be easily eliminated by the body", comments François Treussart, physics professor at the ENS.

However, he seems a bright future for the technology. "Far beyond the [project] goals, nanodiamond future in medical applications is more as a diagnostic device in personal medicine or as a monitoring tool for example to track stem cell engraftment in regenerative medicine, as recently demonstrated by the biomedical applications of fluorescent ND-team at the Institute of Atomic and Molecular Science, at the Academia Sinica inTaiwan," he concludes.

A NDP-probe, placed in a target cell, should be able to detect and relay information about the processes taking place in this cell. "The Dinamo project has been finished, but the partners still are collaborating," Nesladek tells. "The University of Stuttgart in Germany is developing a NDP-probe. "Dinamo has focused on the context of breast cancer and colorectal cancer, but there is no reason why the technique could not be applied to a wide range of other cancers," he tells CommNet. He concludes that another future aim is to explore the possibility of using NDP probes to detect cancer stem cells.

More information: www.fp7-dinamo.eu/

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