Nanomotors for targeted cancer therapy

Troubleshooters: Nanomotors can be directed to cancer cells using magnetic fields," says Ambarish Ghosh (left).

Research on nanomotors for various medical applications is an emerging field in nanoscience and researchers from Indian Institute of Science (IISc), Bengaluru, have had a measure of success.

The researchers have developed a new type of zinc-ferrite–coated magnetic nanomotors that are highly stable (which do not agglomerate in solution over long periods of time) and can generate localised heating to kill cancerous cells. The results were published in *Nanoscale.*

Measuring just about 3 microns in size, the magnetic nanomotors can be manoeuvred in different biological environments like blood, tissue etc using rotating magnetic fields of less than hundred Gauss (safe level for human beings) and targeted to the area of interest in the body. They are popular due to their non-invasive nature and the absence of the need for chemical fuel to propel them.

"We can inject these ferric nanomotors directly into the tumour or guide them to the area of interest using magnetic fields," says Lekshmy Venugopalan, Research Associate at IISc's Centre for Nano Science and Engineering and first author of the paper.

Hyperthermia experiments were carried out using these nanomotors on human cervical cancer cells in the lab. "On applying the appropriate magnetic field and frequency for about 20 minutes the temperature rises by 7-8 degrees Celsius — the window of cell death. The generated heat was high enough to kill the cancerous cells," adds Lekshmy. Nanomotors of 2 mg/ml caused about 50% cell death in 20 minutes. "The nanomotors are biocompatible and *in vivo* studies are being carried out to understand how it will be processed in the body."

"The current limitations of cancer therapies including inaccessible locations in the body and drug resistant tumours could be overcome with such tiny heat-generating motors irrespective of the type of cancer," says Shilpee Jain, DST INSPIRE faculty fellow at the institute and co-author of the paper.

Silicon dioxide forms the backbone of these nanomotors and magnetic material such as iron is deposited on top of it. The zinc ferrite coating is then applied to provide multifunctional properties such as enhanced physical and chemical stabilities, and magnetic hyperthermia potential.

"These new developments have sorted out some long-standing technological issues like agglomeration of the nanomotors," says Ambarish Ghosh, corresponding author of the paper. "Future research in this area would be directed towards *in vivo* experiments. More studies on combining drug release with magnetic hyperthermia need to be carried out. The targeted therapy could have great implications for cancer therapeutics."

Perkin discovered the first synthetic dye, known as mauveine.

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