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Science news

Glow imaging for living things

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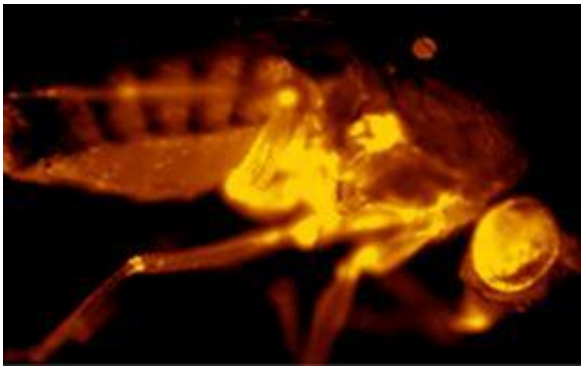
In a technique that can potentially transform medical imaging, researchers at the Indian Institute of Technology in Kanpur (IIT-K) have used glowing nanoparticles as a probe for imaging the entire life cycle of the fruit fly *Drosophila melanogaster*.

Drosophila is one of the most prominent models used by scientists to study developmental biology. "A simple, non-invasive, fluorescence-based technique for imaging all the developmental stages (from egg to adult) of *Drosophila melanogaster* is, to the best of our knowledge, not known (until now)", chemistry professor Sabyasachi Sarkar and co-workers report[1]. This technique may be used for imaging animals, "and could be extended to human beings", they claim.

Real-time X-ray and magnetic resonance imaging (MRI), conventionally used for biomedical diagnosis, are costly, time consuming and have operational difficulties, Sarkar told *Nature India*. And the current approach of injecting appropriately 'wrapped' semi-conducting materials for imaging living species suffers from toxicity problems while fluorescence proteins used for this purpose require genetic modification apart from being unstable. The IIT-K researchers were, therefore, looking for a simpler system and they believe their novel methodology based on fluorescent carbon nanoparticles "opens up the prospect of optical imaging of living species" at an affordable cost.



The fruitfly imaged with the glowing nanoparticles.

The centrepiece of their technology is fluorescent, onion-shaped nano-carbon readily soluble in water. Carbon 'nano-onions' — also called giant fullerenes — are multi-shelled nanoparticles, 3-5 nanometres in diameter, that consist of concentric graphitic layers and a hollow core. Nano-onions are known since 1980. The IIT-K team, working with a grant from the Indian government's Department of Science and Technology under the 'Nano initiative' programme, have now used a simple method to produce nano-onions. They followed the primitive method of burning carbonaceous material like wood waste in the absence of oxygen (pyrolysis).

The nano-onions thus produced were rendered water soluble (through surface oxidation with carboxylic acid groups) and made fluorescent through a process called 'surface passivation'. The water-soluble fluorescent nano-onions were then selectively filtered through micropore filters to get the smallest possible sizes for imaging the fruit fly.

For their experiment the water-soluble nano-onions were uniformly mixed with the fruit fly's standard dietary food — corn syrup-sucrose-agar. A few pairs of *Drosophila melanogaster* were fed this meal prior to laying eggs enabling the flies to be imaged alive. "The development from egg to adulthood was monitored by optical fluorescence microscopy," Sarkar said.

"Oral ingestion of up to 4 ppm of soluble carbon nano-onions allows the imaging of all the stages of the fruit fly life cycle," the scientists report. "We did not find any toxicity of water-soluble carbon nano-onions on exposed flies in terms of their morphological appearance thus demonstrating that carbon nano-onions are readily removed from the body" and do not affect the normal activity of the fruit flies, they

said.

"The fruit flies continued to proliferate to the next generation after withdrawal of the carbon nano-onions from their food supply, demonstrating a return to their normal lives."

"The oral ingestion of a fluorescent probe is a new approach to imaging a living species," Sarkar said. Another advantage of this technique, according to the report, is "colourful imaging is possible to render better contrast without the use of any perishable external organic colouring molecules or fluorescence proteins".

Following successful demonstration of the technique in fruit flies, the IIT-K team is currently in the process of imaging the life cycle of zebra fish. The researchers believe these carbon nano-onions can also be used as drug carrier molecules and the entire drug delivery process can be developed and visualised.

In Sarkar's view the imaging material being non-toxic to the body "possesses unlimited possibilities." Most importantly, he says, unlike X-rays or MRI, the imaging material used "is of low cost and therefore can be used for anyone in need".

References

1. Ghosh, M. *et al.* Carbon Nano-onions for Imaging the Life Cycle of *Drosophila Melanogaster*. *Small*. doi: **10.1002/smll.201101158** (2011)

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