IMAGING

Glow-in-the-dark nanoparticles for deep imaging

A class of semiconductor polymer particles can be used for afterglow imaging to avoid autofluorescence when imaging deep structures in living animals.

Optical imaging is an important approach to study physiological and pathological processes in living organisms. A major obstacle in these studies is tissue autofluorescence. Molecular afterglow imaging avoids autofluorescence by temporally separating the excitation of fluorophors and the collection of the emitted light. Fluorophores that have been available so far, however, suffer from potential toxicity issues. That is why Kanyi Pu and colleagues from Nanyang Technological University in Singapore designed semiconductor polymer nanoparticles (SPNs) that are nontoxic and emit light even after the excitation light has been switched off.

Using long wavelengths for excitation and emission facilitates the imaging of structures deep in living animals as light scattering is minimized. Therefore, the researchers focused on SPN-NCBS5 nanoparticles, as their absorption and emission peaks in the near-infrared region (NIR) are particularly suited for live imaging. SPN-NCBS5 particles are fluorescent as well, and the researchers directly compared signal-to-background ratios (SBR) of fluorescence and afterglow signals. When imaging through the skin of a living mouse, the SBR was 120 times higher for afterglow imaging compared to NIR fluorescence imaging. Importantly, afterglow is suitable for long-term *in vivo* imaging, as the afterglow could be repeatedly recharged.

The researchers applied afterglow imaging with SPN-NCBS5 to map lymph nodes or to visualize tumors in mice. They found that they could even preirradiate SPN-NCBS5 a day before introducing the particles into the animals. This means that there is no need for real-time excitation during imaging, which simplifies the experimental setup.

In another application, the researchers generated an activatable nanoprobe called SPN-thiol. Without the presence of biothiols such as cysteine, homocysteine and glutathione that are important for protection against oxidative stress, the afterglow signal is quenched. In the presence of cysteine, however, SPN-thiol is activated, and its afterglow can be visualized. Using SPN-thiol, the researchers could detect drug-induced hepatoxicity as early as 30 minutes after the application of acetaminophen.

Because of the resolved toxicity issue, increased half-life and the NIR excitation and emission, the new SPNs are a promising tool for deep-tissue imaging of living animals.

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RESEARCH PAPERS

Miao, Q. *et al*. Molecular afterglow imaging with bright, biodegradable polymer nanoparticles. *Nat. Biotechnol.* **35**, 1102–1110 (2017).