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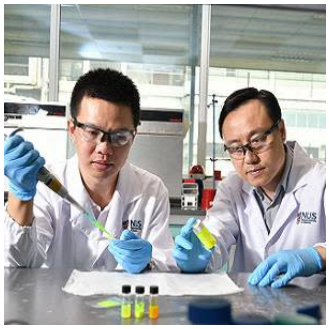
NUS invention may lead to safer, cheaper x-ray imaging



Scientists from the National University of Singapore (NUS) have developed novel lead halide perovskite nanocrystals that are highly sensitive to x-ray irradiation. When used as a scintillator material in x-ray imaging, these nanocrystals can reduce the required radiation dose to deliver higher resolution imaging.

A crucial part of x-ray imaging technology is scintillation, which is the conversion of high-energy x-ray photons to visible luminescence. Most scintillator materials used in conventional imaging devices comprise expensive and large inorganic crystals that have low light emission conversion efficiency. Hence, they will need a high dose of x-rays for effective imaging.

The NUS team, led by Professor Liu Xiaogang from the Department of Chemistry, incorporated the perovskite nanocrystals into flat-panel x-ray imagers, allowing them to create a new type of detector that could sense x-rays at a radiation dose about 400 times lower than the standard dose used in current medical diagnostics. These nanocrystals, compared to the inorganic crystals used in conventional x-ray imaging machines, are also cheaper as they can be produced using simpler, less expensive processes and at a relatively low temperature.

From their experiments, Prof. Liu and his team found that their nanocrystals can detect small doses of x-ray photons and convert them into visible light. They can also be tuned to light up, or scintillate, in different colours in response to the x-rays they absorb. With these properties, these nanocrystals could achieve higher resolution x-ray imaging with lower radiation exposure.

"Our technology uses a much lower radiation dose to deliver higher resolution images, and it can also be used for rapid, real-time x-ray imaging. It shows great promise in revolutionising imaging technology for the medical and electronics industries. For patients, this means lower cost of x-ray imaging and less radiation risk," according to Prof. Liu.

The team's research breakthrough was the result of a collaborative effort with researchers from Australia, China, Hong Kong, Italy, Saudi Arabia, Singapore and the U.S. It was first published in the online edition of Nature on 27 August 2018, and a patent for this novel technology has been filed.

X-ray imaging technology has been widely used for many applications since the 1890s. Among its many uses are medical diagnostics, homeland security, national defence, advanced manufacturing, nuclear technology, and environmental monitoring.

To test the application of the lead halide perovskite nanocrystals in x-ray imaging technology, the NUS team replaced the scintillators of commercial flat-panel x-ray imagers with their nanocrystals.

"Our experiments showed that using this approach, x-ray images can be directly recorded using low-cost, widely available digital cameras, or even using cameras of mobile phones. This was not achievable using conventional bulky scintillators," said Dr. Chen Qiushui, a Research Fellow with the NUS Department of Chemistry and the first author of the study.

To validate the performance of their invention, the NUS scientists will be testing the abilities of the nanocrystals for longer times, and at different temperatures and humidity levels. The team is also looking to collaborate with industry partners to commercialise their novel imaging technique.

Source: National University of Singapore
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