Source: *The Straits Times,* pB10
Date: 25 October 2018

Using a mobile phone to take X-ray images

NUS scientists create X-ray sensor thin enough to allow light to pass through

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It is now scientifically possible to take X-ray images with a mobile phone or a digital camera, and to create these ghostly scans in almost all the colours of the rainbow.

And where making the crystals that turn X-rays into visible light used a highly toxic process that involved up to 1,700 deg C of heat, Singapore-based scientists can now safely create the crystals at less than 100 deg C – the temperature of boiling water – while wearing no more protection than a lab coat.

The researchers behind the discovery are already in talks with 10 companies from countries such as Finland, China and the United States, despite publishing their findings only this August.

The nanocrystals central to this discovery have long been used by the solar power industry to turn sunlight into energy, said Professor Liu Xiaogang of the National University of Singapore (NUS) Faculty of Science. "Nobody knew that they could be used for X-rays," said Prof Liu, who is from the department of chemistry.

Just as placing a hand between a torchlight and a wall casts a shadow of the hand on the wall, X-ray images are created by placing an object between a machine that fires X-rays and a screen that captures the "shadows" cast by the object.

A critical part of the screen is made up of crystals that turn these X-rays into visible light.

Relatively high doses of toxic X-rays would have to be fired at these crystals to create clear images.

The crystals are relatively large, time-consuming to make and expensive. They also need to be produced at extremely high temperatures of up to 1,700 deg C in a process that releases toxins.

Dr Chen Qiushui, a research fellow with the NUS department of chemistry and part of Prof Liu's team, first discovered in 2015 that the nanocrystals widely used in solar power generation could also convert X-rays to light.

After further experimentation, the team found that these nanocrystals were much more sensitive to X-rays than the traditional crystals used in X-ray machines.

By modifying the amount of chlorine, bromine or iodine in the nanocrystals, the team could also colour the X-ray images different shades of blue, green, yellow and red.

More importantly, they could apply a nanocrystal solution uniformly and thinly onto a surface and let it dry. This contrasts with the traditional methods of growing crystals as solids.

This large difference in thickness of the crystals – 80 micrometres as opposed to 500 micrometres in the traditional method – means that light can pass through the nanocrystals to create an image that a digital camera or even a mobile phone can capture.

The X-ray image of the beetle specimen (left) was taken by National University of Singapore researchers using a digital camera. This was possible because the sensor they developed (above) uses nanocrystals that are thin enough for visible light to pass through.
PHOTOS: NATIONAL UNIVERSITY OF SINGAPORE

Current technology requires the image to be transmitted to a display through a cable.

This thinness also means that X-ray detectors can be made bendable.

Dr Chen said this could be useful to technicians who want to X-ray pipes from the inside, for instance.

However, do not expect to be able to take images yourself.

One still needs special training as it is still highly toxic to stand in front of an X-ray emitting machine, said Prof Liu.

"Our creation... has significant implications for many fields of research and opens the door to new applications.

"We hope that this new class of high-performance X-ray sensors can better meet tomorrow's increasingly diversified needs."

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