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Researchers uncover new light harvesting potentials

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Researchers for the first time have found a quantum-confined bandgap narrowing mechanism where UV absorption of the graphene quantum dots and TiO_2 nanoparticles can easily be extended into the visible light range.

Such a mechanism may allow the design of a new class of composite materials for light harvesting and optoelectronics.

Dr Qin Li, Associate Professor in the Environmental Engineering & Queensland Micro- and Nanotechnology Centre, says real life application of this would be high efficiency paintable solar cells and water purification using sun light.

"Wherever there is abundant sun we can brush on this nanomaterial to harvest solar energy to create clean water," she says.

"This mechanism can be extremely significant for light harvesting. What's more important is we've come up with an easy way to achieve that, to make a UV absorbing material to become a visible light absorber by narrowing the bandgap."

Visible light makes up 43 per cent of solar energy compared to only 5 per cent possessed by UV light.

Major efforts have been made to improve titania's absorption of visible light or develop visible-light sensitive materials in general.

Methods used for titania, including metal ion doping, carbon doping, nitrogen doping and hydrogenation usually require stringent conditions to obtain the modified TiO2 such as elevated temperature or high pressure.

In their innovative paper published in *Chemical Communications*, a Royal Society of Chemistry journal, the researchers observed that when TiO2 particles are mixed with graphene quantum dots, the resulting composite absorbs visible light by a quantum-confined bandgap narrowing mechanism.

"We were really excited to discover this: when two UV absorbing materials, namely TiO_2 and graphene quantum dots, were mixed together, they started to absorb in the visible range, more significantly, the bandgap can be tuned by the size of graphene quantum dots," says Dr Li.

"We named the phenomenon 'quantum-confined bandgap narrowing' and this mechanism may be applicable to all semiconductors, when they are linked with graphene quantum dots. Flexible tuning of bandgap is extremely desirable in semiconductor-based devices."

This work has been selected to feature in the front inside cover of *Chemical Communications* today (July 14). The team's work on the fluorescence mechanism of graphene quantum dots recently has also been featured in *Nanoscale*.

Provided by Griffith University