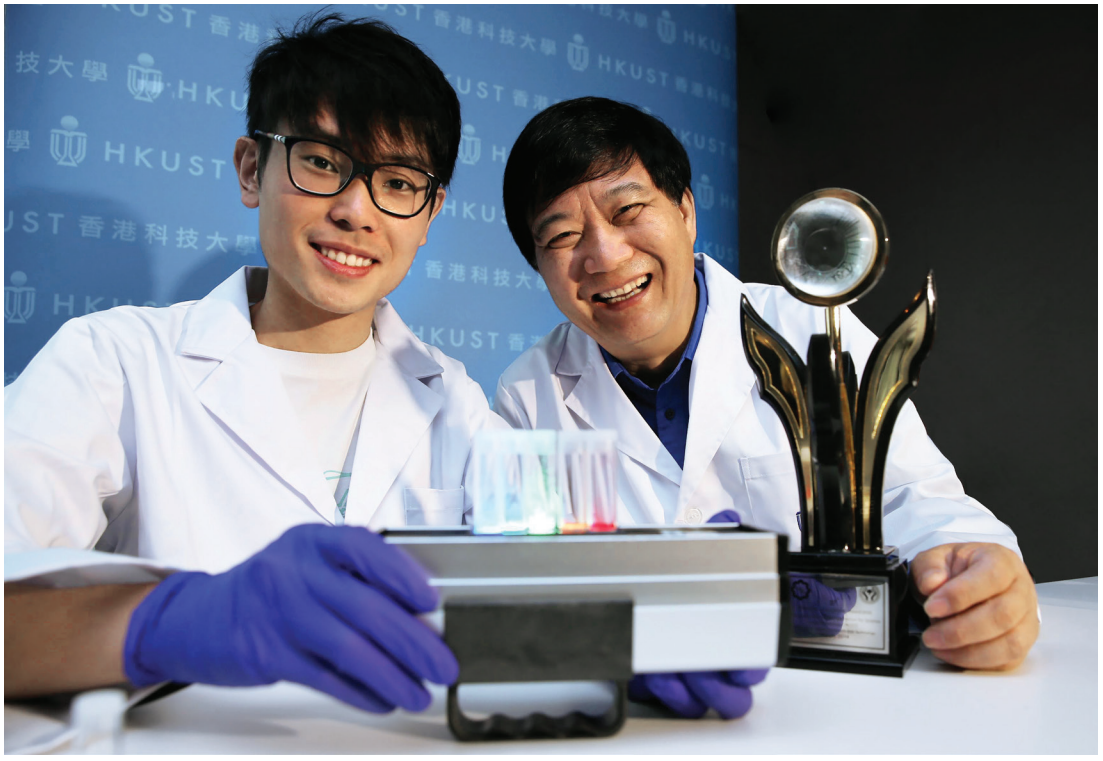
GLOWING SUCCESS

Chemists at HKUST are leading a revolution in luminescence



Prof Ben Zhong Tang (right) received the Khwarizmi International Award (Second Class) from the Iranian Organization for Science and Technology in 2014 for his research into AIE-gens.

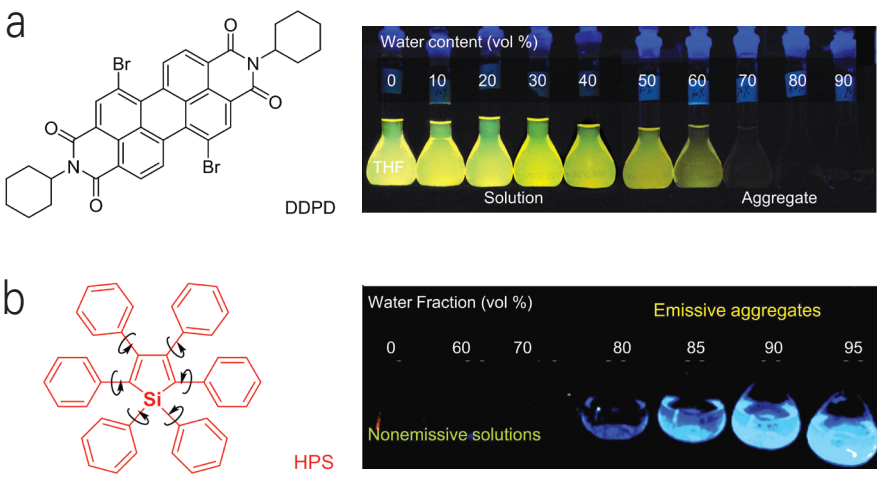
Novel light-emitting molecules created through the curiosity-inspired research of Prof Ben Zhong Tang could bring quantum improvements in key technologies we rely on today, ranging from biomedicine and healthcare to opto-electronics. Prof Tang, Chair Professor of Chemistry and Biomedical Engineering, is the father of "aggregation-induced emission" (AIE). Prof Tang and his team have already discovered hundreds of AIE materials, including one used for tracking cancer cells inside the human body, another for more effective visualization of fingerprints, yet another for assaying bacterial activities.

Prof Tang's endeavors, spurred by an experimental anomaly observed in 2001, led to the identification of molecules that emit light when crowded together, a concept Prof Tang named AIE. Driven by the spirit of enquiry to explore further, Prof Tang went on to research AIE phenomena, processes, theories and applications. He has gained national and international recognition for his discoveries.

In December 2015, HKUST gained approval from the Ministry of Science and Technology to establish the Hong Kong Branch of Chinese National Engineering Research Center (CNERC) for Tissue Restoration and Reconstruction. The Center

> "We have been working on AIE-gens for a decade and a half but there is much more still to uncover. Seeing research that started with the simple question 'why?' develop into a global field of discovery is tremendously exciting. A whole new world is opening up"
>
> **PROF BEN ZHONG TANG**
> Stephen K.C. Cheong Professor of Science, Academician, Chinese Academy of Sciences

Potential Applications of AIE Materials



Traditional light-emitting materials often emit weak or no light in concentrated solutions or in a solid state. This is known as "aggregation-caused quenching" (ACQ) (Figure a).

In 2001, Prof Tang and his team discovered abnormal emission behavior in some molecules, where aggregation played a constructive instead of a destructive role. A series of silole derivatives while non-emissive in dilute solutions were found to be highly luminescent when aggregated or cast into solid films (Figure b).

Since light emission is induced by aggregate formation, the process was named "aggregation-induced emission" (AIE), which is the exact opposite of ACQ.

in Hong Kong will be headed by Prof Tang and will concentrate on new luminescent materials and their hi-tech applications in biomedical sensors and chemical probes. Such work could benefit numerous fields, including detection, imaging, quarantine, inspection, diagnosis, environmental protection and homeland security. The Center will also encourage academic, research and development, and industry collaboration.

Earlier, in 2012, the Ministry of Science and Technology of China incorporated AIE into its National Basic Research Program – also known as the 973 Program – and awarded Prof Tang a RMB30 million (US$4.6 million) grant for further development of AIE. In addition, Prof Tang and his AIE research have been the subject of high-profile overseas media reports, including a recent feature in *The New York Times*, an interview by CNBC and a news feature article in *Nature*.

Previously, aggregation was seen as detrimental to light emission because most light-emitting molecules dimmed in their solid form/condensed state, a phenomenon known as "aggregation-caused quenching" (ACQ).

Through experiments, Prof Tang's team discovered that the intriguing mechanism behind the AIE phenomenon lies in the shape of the molecule. Most light-emitting molecules are flat and stack together when crowded, which extinguishes their luminescence. In contrast, AIE-gens are often propeller shaped, so they lock together when crowded and are forced to release their energy as photons.

"This was conceptually new," Prof Tang explained. "Once you have a new concept, you can build a platform for future development." Scientists across the world responded. Numerous papers have been published independently or in partnership with the HKUST chemists and, in 2013, AIE was among the top 100 research topics, according to Thomson Reuters.

"The promise of AIE materials is extensive. They can help improve our practical capabilities in many different fields. These benefits for society are what make such research so worthwhile to pursue," Prof Tang said.