

Perovskite light-emitting diodes based on spontaneously formed submicrometre-scale structures

With the support by the National Natural Science Foundation of China, the research team directed by Academician Huang Wei (黄维) and Prof. Wang JianPu (王建浦) at the Institute of Advanced Materials (IAM), Nanjing Tech University (NanjingTech), recently reached a milestone in perovskite light-emitting-diodes (LEDs), demonstrating a record external quantum efficiency (EQE) of 20.7%, which was published in *Nature* (2018, 562: 249–253).

Solution-processed organometal halide perovskites have received considerable attention in LED applications due to their high photoluminescence quantum efficiency (PLQE), good charge mobility and excellent colour purity. However, the defects and leakage current associated non-radiative recombination in three-dimensional perovskites limit the device efficiency. Previously, they developed multiple-quantum-well perovskites with high PLQE of $\sim 70\%$ and good film uniformity, resulting in high performance LEDs with EQE of up to 11.7% (*Nature Photonics*, 2016, 10: 699–704). However, as other planar LEDs, most of the light generated from the emitters is trapped in the device, which further limits the efficiency. The traditional strategies to enhance light outcoupling efficiency of LEDs usually involve complicated fabrication processes, and can distort the light-output spectrum and directionality.

Their group demonstrates a solution-processed submicrometre-scale structured perovskite to efficiently extract light from the device. It possesses a randomly distributed structure, which can retain wavelength- and viewing-angle-independent electroluminescence. These perovskites are achieved simply by introducing additives into the perovskite precursor solutions. The perovskite LED exhibits a high EQE of 20.7% and a high energy-conversion efficiency of 12% at a high current density of 100 mA cm^{-2} , which approach those of the best-performing organic LEDs.

This finding suggests the unique possibility of solution-processed perovskite LEDs to achieve high efficiency electroluminescence at high brightness.

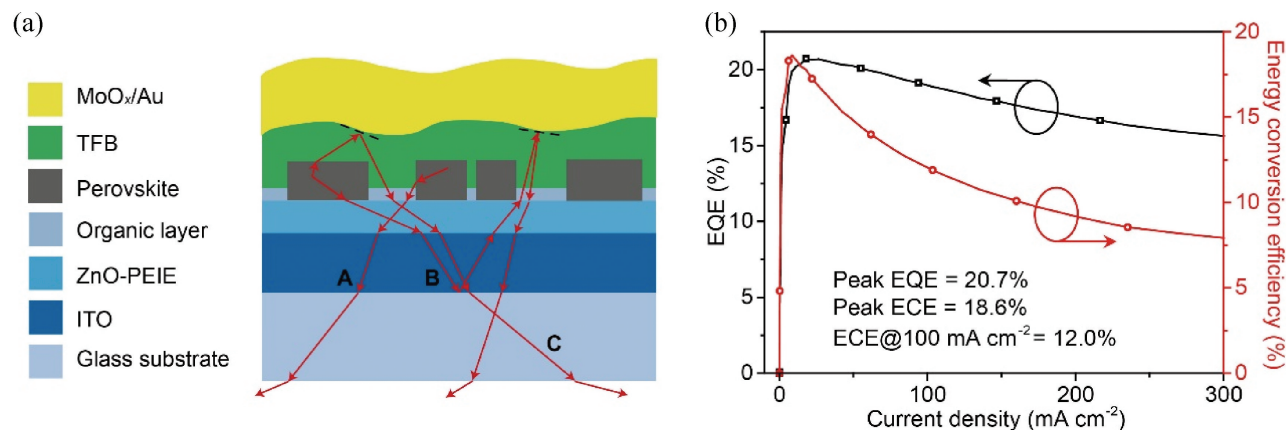


Figure (a) Schematic diagram of the perovskite LED with the submicrometre-scale structure. (b) Characteristics of their perovskite LEDs. (*Nature*, 2018, 562: 249–253)