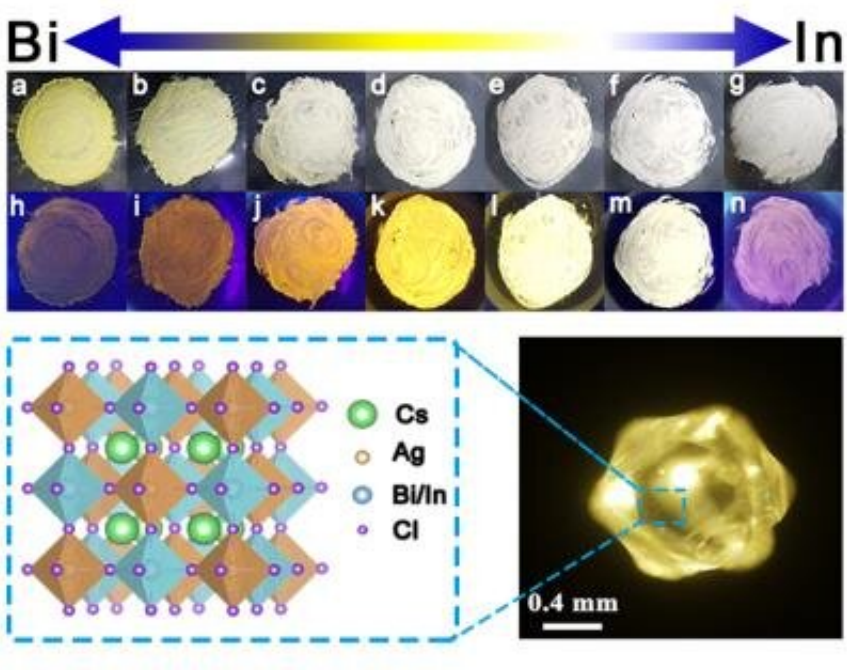
New record in lead-free halide double perovskites

July 22 2019



The luminescence property of $Cs_2AgBi_{1-x}In_xCl_6$ (0 $_2AgBi_{0.125}In_{0.875}Cl_6$ bulk crystal. Credit: Science China Press

Illumination consumes more than 20 percent of electricity. Thus, finding an efficient, stable, single-phase warm white-light material is very important. Lead hybrid perovskites have drawn interest for excellent photoelectric performance and simple synthesis. Lead perovskites with white-light emission have been studied, but photoluminescence quantum efficiencies (PLQEs) are low. However, the large-scale application of

lead perovskites is hindered by toxicity and instability. Therefore, the substitution of Pb with less toxic or non-toxic elements and the replacement of organic cations with relatively stable inorganic cations is being investigated.

Very recently, Keli Han's group at the State Key Laboratory of Molecular Reaction Dynamics, Dalian Institute of Chemical Physics, Chinese Academy of Science, reports a series of bulk lead-free double perovskites: $Cs_2AgBi_{1-x}In_xCl_6$ (0 $_2AgInCl_6$ bulk crystal. The $Cs_2AgBi_{0.125}In_{0.875}Cl_6$ breaks the parity-forbidden transition and shows warm white-light emission with broad emission across the entire visible spectrum, with the highest PLQE of 70.3%.

The $Cs_2AgBi_{0.125}In_{0.875}Cl_6$ nanocrystals and microcrystals are synthesized. They reveal that the PLQE decreases with the size decreasing, due to the enhancement of PL quenching effect caused by the increase of permanent defects. Furthermore, the $Cs_2AgBi_{0.125}In_{0.875}Cl_6$ bulk crystal possesses excellent stability, and therefore, seems promising as a new highly efficient warm white-light emitting material in applications of LEDs.

More information: Peigeng Han et al, Size effect of lead-free halide double perovskite on luminescence property, *Science China Chemistry* (2019). DOI: 10.1007/s11426-019-9520-1

Provided by Science China Press