Abstract

Perovskite solar cells (PSCs) have been received great interest in recent years due to the rapid increase of their solar power conversion efficiency (PCE). However, in order to commercialize PSCs there are still many challenges need to be solved, including fabricating high efficiency and highly stable PSCs using simple, scalable, affordable and eco-friendly process technologies. In this talk, I will introduce several efforts our team have done towards this objective. First, by simply adding 4-tert-butylpyridine (tBP) into the PbI2 precursor solution to enhance its hydrophobicity, we can fabricate highly stable PSCs in ambient air with PCE > 12.5% using spin coating method. Then I will present our work on improving PSCs performance and stability using inorganic perovskite quantum dots (QDs). All-inorganic cesium lead halide perovskite (CsPbX3, X = Cl, Br, I) nanocrystals (NCs) have been prepared, which exhibit near-unity photoluminescence (PL) quantum yields, narrow emission peak widths and anion-tunable absorption/emission wavelengths. By introducing stable α-CsPbI3 quantum dots (QDs) as an interface layer between the perovskite film and the hole transport material (HTM) layer to improve the energy band matching, the PCE of devices has been increased from 15.17% to 18.56%, with substantial improvement on stability as well. Thirdly, we have developed a heat assisted spin-coating process to fabricate PSCs with inverted structure and using anti-solvent process, but which allows us avoid using the toxic solvents such as toluene and chlorobenzene. The PCEs can reach 19.12% on glass substrate and 14.87% on flexible PEN substrate. Over 80% of the initial PCEs can be remained for 20 days in air without encapsulation, and for 60 days under simple encapsulation. Finally, I will introduce our work on developing new hole transporting materials to replace Spiro-OMeTAD in order to fabricate high-efficiency and stable PSCs with much lower cost.

Bio of Prof. Cheng

Professor Cheng received the doctorate degree (2009) in Nano Science and Technology at the Hong Kong University Science & Technology(HKUST). He did a postdoctoral research at the department of physics at HKUST (2009-2011), Berkeley Laurence National Laboratory and the University of California at Berkeley (2011-2013). In 2013, Professor Cheng joined in the department of materials science and engineering of Southern University of Science and Technology as an associate professor. He was awarded “Outstanding Youth” (2015), “Excellent Young Teacher” (2015) , “Young Talents” (2015), “Nanyue Excellent Teacher”(2018) of Guangdong Province, the selector of “Peacock Project” of Shenzhen (Class B, 2013), “The Youth Scientific Research Award” of Shenzhen (2016), MRS Member, a trustee of Shenzhen Association of Oversea Talents and Association of Young Scientists and Technologists, a committee member of Professor Association of SUSTech. The main research interests include smart materials, energy materials, two-dimensional inorganic flexible electronic materials and devices, etc. Professor Cheng have published more than 80 articles in the international professional journals, cited>1500times, H-index 23, include Nature Comm., Nano Lett., ACS Nano, Adv. Matter., J. Am. Chem. Soc. etc. He is hosting and participating the national, provincial, and municipal fund projects more than 10 as core researcher, the total funds more than 70 million yuan, of which the research group funds more than 20 million yuan. He is an expert reviewer of the National Natural Science Foundation of China and many kinds of science and

technology fund projects of Guangdong Province and Shenzhen, a reviewer of Nano Lett, ACS Nano, Adv. Mater and a member of editorial board of Elsevier–Journal of Science: Advanced Materials and Devices'