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Materials Science Lecture Series

Progress of perovskite solar cell R&Ds and next directions of research with all inorganic and lead-free perovskites

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This year, we are celebrating 10 years of perovskite solar cell (PSC). Since our first discovery of PSC in 2009, enormous efforts have been put into different aspects of PSCs and the progress has been incredibly fast on all fronts. While preparing a comprehensive review on the background, on-going R&Ds, and future direction of PSC research recently, we realized that, although efficiency level has gone beyond 24%, PSCs face serious challenges of practical stability and durability required for industrialization. Although compositional engineering of perovskites by mixing different cations and anions, using modulator molecules and mixing 2D and 3D structures have doubtlessly improved the stability of perovskites against heat and moisture, use of organic moieties still remain a challenge to improve the stability further. Intrinsic stability of the perovskite crystal structure and robust properties of carrier transport materials are going to be the keys to the long term durability of the device. In this respect, use of all-inorganic perovskite materials and dopant-free carrier transport materials is highly desired. We have conducted some work in this direction which includes stabilization of $CsPbI_3$ black phase and use of dopant-free hole transport materials (HTMs). Dopant-free HTMs with all-inorganic perovskites have yielded sufficiently high efficiency of 15% and stability testing of these devices is underway. In addition to stability testing in lab, we have explored stability of PSCs in space for its application in satellites. As found in this investigation, perovskite materials demonstrate high stability and tolerance against exposure to severe space environment having high energy particle irradiations (proton and electron beams). Thin absorbers (<500 nm) avoid accumulation of particles and due to intrinsic defect tolerant nature of perovskites, radiation-induced collision damage is highly suppressed. For space satellite missions, use of dopant-free materials in PSCs is essential because the satellite is exposed to daily temperature change between -80 °C and +100 °C.
The lecture will also introduce our current efforts in making PSCs based on both lead and lead-free perovskites, and future perspectives of perovskite photovoltaics.

Date & Venue

May 10, 2019
17:15-18:15
Hörsaal 2
Department of Chemistry

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