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Perovskite thin film formation: An *in situ* investigation of blade coating to consistently produce high quality, pin hole-free films

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Organic-inorganic hybrid lead halide perovskite semiconductors have attracted a great deal of attention because of their remarkable optoelectronic properties which make them potentially suitable as active materials in photovoltaics, light emission, and photodetection. The key reason for its popularity is that it can yield good semiconductor properties despite being solution processed in ambient conditions and requires no vacuum or excessive heating. To date, the most efficient perovskite solar cells have been fabricated using spin coating, for which several ink and solvent engineering methods have been developed and perfected. However, this is a wasteful process which cannot be easily scaled up to continuous large area fabrication, where existing solvent engineering methods, such as anti-solvent dripping, are also unlikely to work. Here we compare the ink solidification and film formation mechanisms of $CH_3NH_3PbI_3$ in DMF by spin-coating versus blade-coating using *in-situ* time-resolved optical metrology and x-ray scattering. We show significant differences in the process kinetics and formation of complex intermediate phases between the two processes at room and intermediate temperatures. To overcome these challenges in the context of blade coating, the sample is heated during deposition. We observe high-quality film formation for $T > 100^oC$, namely in conditions which inhibit the formation of the crystalline intermediate complex phases. In doing so, we achieve fast and direct formation of the perovskite phase with solar cells yielding PCE > 17%.

Biography

Rahim Munir is a doctoral candidate at King Abdullah University of Science and Technology (KAUST) and affiliated with the KAUST Solar Center (KSC), where he works on understanding the structure-properties-performance relationship for perovskite solar cells. He completed his MSc degree from the Korea Advanced Institute of Science and Technology (KAIST). He leads a team of scientists from KAUST to perform x-ray based experiments at Cornell High Energy Synchrotron Source (CHESS). Munir is an active member of the Materials Research Society (MRS) and played major leading roles in the MRS-KAUST Student Chapter. He publishes articles on his personal blog and is a volunteer science writer for MRS Bulletin. He has given several invited talks about leadership and communication skills and has encouraged students of Saudi universities to pursue science and engineering as their career. Recently, he organized the "Academic Writing" symposia during the 2016 MRS Fall Meeting in Boston. In his free time, he enjoys reading Oriental philosophy.

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