

## Efficient planar heterojunction mixed-halide perovskite solar cells deposited via spray- deposition

Alexander T. Barrows, Andrew J. Pearson, Chan Kyu Kwak, Alan D. F. Dunbar, Alastair R. Buckley and David G. Lidzey

We report the use of ultra-sonic spray-coating under ambient conditions as a deposition technique for the fabrication of planar heterojunction  $\text{CH}_3\text{NH}_3\text{PbI}_{3-x}\text{Cl}_x$  perovskite solar cells. We make a first optimization of processing parameter space using this deposition technique, and explore the role of the temperature of the substrate during spray-casting, the volatility of the casting solvent and the post deposition anneal on determining the efficiency of the resultant solar cells. We find that maximum device efficiency is correlated with the creation of dense films having a surface coverage above 85%. When such films are incorporated into a solar cell device, power conversion efficiencies of up to 11% are realized. These results demonstrate that spray-coating can be used in the large-area, low-cost manufacture of high efficiency solution-processed perovskite solar cells.

*Energy and Environmental Science*, **7**, 2944-2950 (2014)

DOI: 10.1039/C4EE01546K