

Control over self-doping in high-band gap perovskite films

Michael Kulbak¹, Igal Levine¹, Einav Barak-Kulbak¹, Gary Hodes¹, Doron Azulay², Oded Milo²,
Isaac Balberg^{2*} and David Cahen^{1*}

¹*Dept. of Materials & Interfaces, Weizmann Inst. of Science, Rehovot 76100, Israel*

²*The Racah Institute, The Hebrew University, Jerusalem 91904, Israel*

The effects of different cations and anions on carrier diffusion lengths and formation of a junction in high bandgap halide perovskite (HaP) film-based solar cells is studied in detail. HaP cells are of interest as high bandgap ones in solar spectrum splitting for boosting solar to electrical energy conversion efficiency/area by adding them to c-Si photovoltaic cells and driving photo-electrochemical reactions for chemical energy storage. Resolving how the addition of cations and anions change the (unintentional) doping of the HaP is of great importance for understanding the film and device physics as well as for performance improvement. We study Pb-based, APbX₃, HaP films, where A can be a mixture of formamidinium, methylammonium and cesium and X a mixture of bromine and chlorine, using a combination of *Dark-conductivity*, *Photoconductivity* and *Steady-State Photocarrier-Grating* (SSPG) techniques [1]. This way we measure the effect of the different cations and anions compositions on the majority and minority carrier diffusion lengths. We also use Electron Beam Induced Current (EBIC), [2] to identify the formation of the junction and built-in voltage and to track the position and size of the space charge region width following the changes in the HaP composition. In some HaP structures, EBIC is needed to measure diffusion length when it is unmeasurable in SSPG. We find mixed-cation HaP form a *p-i-n* junction with relatively long and ambipolar carrier diffusion lengths, in contrast to the single cation based bromide HaPs, who form a *p-n* junction and shorter diffusion lengths.

References

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