



Contribution ID: 251

Type: Poster Presentation

## layered organic-inorganic perovskite films in solar cells

Perovskites of cesium lead halide ( $\text{CsPbX}_3$ ,  $X = \text{Cl, Br, I}$ ) have received a lot of attention due to their relative stability in comparison to their organic-inorganic counterparts. This study synthesized a thin film of cesium lead tribromide ( $\text{CsPbBr}_3$ ) by spin coating followed by dip coating and characterized it through a scanning electron microscope (SEM), ultraviolet-visible (UV-Vis) spectrometer, and X-ray diffraction (XRD) in order to observe its morphological, optical and structural characteristics. SEM micrographs revealed pinholes within the perovskite film that significantly impacted device performance. To address this issue, we show that spin-coating phenethylammonium bromide (PEABr) on  $\text{CsPbBr}_3$  thin films improves morphology and surface coverage. The optical study of  $\text{CsPbBr}_3$  thin film showed a broad UV-Vis absorption with an onset at 530 nm and an excitonic peak at 515 nm. However,  $\text{CsPbBr}_3/\text{PEABr}$  preserves the optical properties of  $\text{CsPbBr}_3$ . Additionally, two excitonic peaks appear at 405 and 436 nm which are attributed to a 2D perovskite  $\text{PEA}_2\text{Csn-1PbnBr}_{3n+1}$  with  $n = 1$  and  $n = 2$  phase. The viscosity of PEABr was also suggested to play a role in the decrease followed by an increase in absorption of  $\text{CsPbBr}_3/\text{PEABr}$  films. XRD results of  $\text{CsPbBr}_3$  film showed the impurity phase of  $\text{CsPb}_2\text{Br}_5$  and a cubic  $\text{CsPbBr}_3$  structure with the  $\text{Pm-3m}$  space group. Furthermore, PEABr had no effect on the intrinsic crystal structure of  $\text{CsPbBr}_3$ . The  $\text{CsPbBr}_3$  solar cell produced a low open-circuit voltage ( $V_{oc}$ ) of 0.3 eV and a fill factor (FF) of 30.89%, which may be due to the loss of charge-carriers in the area with pinholes. This could also explain the device's low power conversion efficiency (PCE) of 0.9%. A mixed-cation solar cell based on  $\text{CsMAFAPb}(\text{IBr})_3$  was also designed and fabricated. This solar cell showed a photoluminescence emission at 766 nm with a charge carrier lifetime of 24 ns, which indicates that it is less prone to degradation. Current density-voltage (J-V) characteristics of  $\text{CsMAFAPb}(\text{IBr})_3$  show a  $V_{oc}$  and a FF of 1.14 eV and 57.32%, respectively. With this device, PCE of 13.89% was also achieved, with a short-circuit current of 23  $\text{mA}/\text{cm}^2$ . We conclude that these results may be related to the low hysteresis experienced at low voltage scan speeds of 10  $\text{mV}/\text{s}$ . All things considered, the addition of an organic spacer to a 3D perovskite improves the morphological, optical, and structural characteristics of the as-prepared 3D perovskite film.

### Apply to be considered for a student ; award (Yes / No)?

Yes

### Level for award;(Hons, MSc, PhD, N/A)?

MSc

**Primary author:** THUBANE, Sandile

**Co-author:** DIALE, Mmantsae (University of Pretoria)

**Presenter:** THUBANE, Sandile

**Session Classification:** Poster Session

**Track Classification:** Track A - Physics of Condensed Matter and Materials