Contribution ID: **251** Type: **Oral Presentation**

Synthesis and Characterization of Caesium Lead Tri-Iodide by Sequential Physical Vapour Deposition for Solar Cells

Thursday, 6 July 2023 14:40 (20 minutes)

In this study, we report on the synthesis and characterization of titanium dioxide thin film prepared via the spray pyrolysis technique. X-ray diffractograms confirmed a tetragonal crystal structure with an average crystallite size of 24.44 nm and a micro-strain of 9.75x10-4. Field-emission scanning electron micrographs show pin-hole-free and densely packed grains with an average size ranging from 25 to 29 nm. UV-Vis spectra revealed an absorption onset 300 nm for the film. The estimated film bandgap was 3.9 eV.
The sequential physical vapour deposition technique was used to grow quality thick films of metal halide perovskites in a safe, scalable, and reproducible manner. Growth of high-quality poly-crystalline yellow phase caesium lead tri-iodide (CsPbI3) was refined by varying the CsI thickness from 200 nm to 500 nm. Crystallographic parameters and phase transitions from as-deposited orthorhombic γ-CsPbI3 to tetragonal β-CsPbI3 on annealing at 100 ℃, were determined using X-ray diffraction patterns. Computed lattice constants were a= 4.88 Å, b= 9.96 Å, and c= 16.52 Å, with an average crystallite size increasing from 169.46 nm to 243 nm, and the micro-strains decreased with an increase of CsI thickness. The field-emission scanning electron micrographs showed a uniform surface covered with polycrystalline grains. The Average grain size increased from 168 to 235 nm as the caesium iodide (CsI) thickness increased, resulting in large pin-hole-free and tightly packed grains. A 2.24 to 2.38 eV increase in the bandgap was observed when CsI thickness was increased. Herein, we demonstrated optimized structural, morphological, and optical properties of CsPbI3 for use in solar cells, grown via sequential physical vapour deposition technique for stable and completely inorganic perovskites. Finally, the electrical properties of fabricated FTO/TiO2/CsPbI3/Au devices were characterized using the current-density (I-V) measurement technique. Although the CsI thickness varied, it had no effect on the cell's performance because the devices showed consistent power conversion efficiency of about 4%. Moreover, the open circuit voltage shows a decreasing trend when CsI thickness decreases.

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

Yes

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

MSc

Primary author: SIBIYA, Sizwe (Abstract)

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

Presenter: SIBIYA, Sizwe (Abstract)

Session Classification: Physics of Condensed Matter and Materials Track 1

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