

**2D - 3D HYBRID PEROVSKITES FOR PEROVSKITE
SOLAR CELLS**

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

Signature: Date:

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The above candidate has carried out research for the Master of Science under my supervision.

Signature of the supervisor: Date:

Dr. Galhenage A.Sewvandi

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ABSTRACT

Hybrid Organic-Inorganic Perovskites (HOIP) have been studied extensively and grown popular. Especially in Three-dimensional (3D) Perovskites, achieving power conversion efficiency (PCE) exceeds 23%. Nevertheless, some of the morphological imperfections will limit their structural capabilities. Pinholes in discontinuous perovskite films induces the huge leakage current which can cut down the device efficiency and creates a short circuit. Therefore, it is essential to deposit a compact film with passivated defects. Two-dimensional (2D) halide perovskites, conversely attracted significant attention and become a positive alternative with their uncomplicated synthesis, stability, and excellent photoelectric properties. This study, investigates the formation and properties of 2D Tetrabutylammonium lead halide (TBAPbBr_xI_{3-x}) HOIP. Tetrabutylammonium ion is a large cation, and more likely forms a 2D perovskite structure which was confirmed by the XRD spectrum. Substantiated by SEM images, TBAPbBr_xI_{3-x} establishing and favors crystals with enhance orientation and few grain boundaries and. However, the absorption spectra of the film shows an excitonic peak at 411 nm and a clear band edge at 450 nm. Resulting in poor absorbance in the visible range, with optical band gap of 2.76 eV, narrowing the ability to use TBAPbBr_xI_{3-x} alone in solar cells. Conversely, TBAPbBr_xI_{3-x} can use as separate capping layer on the top of 3D perovskite layer, enhancing the properties of the 3D perovskite layer. Incorporating TBAPbBr_xI_{3-x} into CH₃NH₃PbI₃ shows a better film formation with few holes. The application of mixed perovskite layers incorporated solar cells will result in better structural and optoelectronic properties.

Keywords— Hybrid Organic-Inorganic Perovskites, Two-dimensional, Tetrabutylammonium lead halide, pinholes

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List of Abbreviations

PV: photovoltaic

PCE: power conversion efficiency

HOIPs : Hybrid Organic-Inorganic Perovskites

PSC: perovskite solar cells

DSSC: dye-sensitised solar cell

MA: methylammonium

FA: formamidinium ion

DMF: N,N-dimethylformamide

TBA: Tetrabutylammonium ion

TBABr: Tetrabutylammonium Bromide

PbI₂: lead(II) iodide

TBAPbBr_xI_{3-x} : Tetrabutylammonium lead bromide/ iodide

MAPbI₃ : methylammonium lead iodide

XRD: X-ray diffraction

SEM: Scanning Electron Microscope

t: tolerance factor

μ : octahedral factor

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