

## Fabrication and characterization of organolead halide perovskite based solar cells



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#### Introduction

The demand for new materials, to improve the power conversion efficiency and to reduce the cost of photovoltaic cells, has triggered our interest to study the Organolead Halide Perovskite based solar cells.

1) Relatively high power conversion efficiency (PCE)

PCE exceeding 16% was demonstrated, and PCE higher than 20% is expected Tunable direct band gap semiconductor (1.3~1.5eV)

Open circuit voltage (Voc~1V)

High electron and hole mobility are already demonstrated

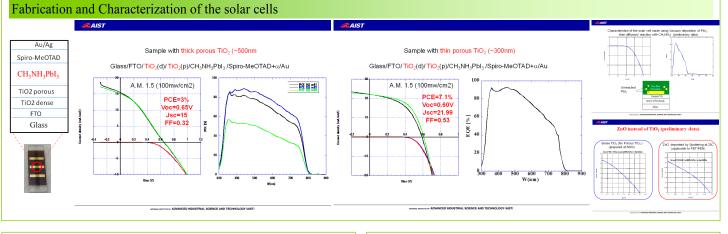
2) Relatively low-cost materials and processing technologies

low-cost and available materials (their toxicity might be an issue) low-cost and low-temperature processing technologies such as printing are possible

#### Experimental

- •The purpose of this study is to identify some of the issues that are facing Organolead Halide Perovskite based solar cells and to explore new solutions.
- •We have synthesized the Organolead Halide Perovskite and fabricated solar cells according to previous works (1). Materials are characterized by x-ray diffraction techniques and solar cells are characterized by recording I-V and EQE spectra.

#### Synthesis of CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> Organolead Halide Perovskite Flow chart and parameters Exploring different approach to make films FTO/Glass 1.0 0.8 TiO2 layer 0.4 FTO patterned by etching with Zn+HCl Rinsed with Dl water, Acetone, 2-propanol O<sub>2</sub> Plasma (18W, 100Pa, 30min) 1) dense TiO<sub>2</sub> made using Ti precursor ( tetra-Glass/FTO substrate CH3NH3PbI3 layer sopropoxide bis(acetylacetonate) ) by spray pyrolysis isopropoxide bis(acetylacetonate)) by spray pyrolysis in air at 500 °C, (10min. 2) porous TiO<sub>2</sub> made using TiO<sub>2</sub> paste (DSL18NR-T) spin coated at 1200 rpm, 60sec Annealed in air at 500 °C, 10–30min. CH<sub>3</sub>NH<sub>3</sub>1 + Pbl<sub>3</sub> + y-butyrolactone (or DMF) solution, spin coated at 1000–2000 rpm, 60 sec Annealed at 100 °C, 1–30min in Ar Glove-Box CH NIJP Bl. structure confirmed by XPD. TiO<sub>2</sub> XRD data of CH<sub>3</sub>NH<sub>3</sub>PbL<sub>3</sub>showing the effect of the annealing temperature: Red 70°C, 30min、green:70°C, 60min、blue:100°C, 30min in Ar Glove-Box, Hot-plate Spiro-OMeTAD layer CH3NH3PbI Anneated at 100 °C, 1-s-Joinin in Ar Glove-Box CH<sub>3</sub>NH<sub>3</sub>Pb<sub>1</sub>, structure confirmed by XRD Spiro-OMeTAD+(Li-salt, TBP, acetonitrile)+Chlorobenzene solution Spin-coated at 3000 rpm, 60sec in Ar Glove-Box 100nm of Au deposition in UHV 2 × 10<sup>4</sup> Pa, 1500°C, 1.0-1.3 Ås<sup>-1</sup> Au layer Spiro-OMeTAD Solar Cell encapsulated electrode



# We have been able to reproduce the reported results, yet we have not reach PCE ~16% Optimizations are in progress (thickness, concentration, uniformity, coverage) We have observed that the purification of the materials and solvents is essential. Encapsulation of the device is also crucial to especially prevent adsorption of water We are exploring different materials and different device structure

#### References / Acknowledgements

(1) "Efficient Hybrid Solar Cells Based on Meso-Superstructured Organometal Halide Perovskites", M. Lee, J. Teuscher, T. Miyasaka, T. N. Murakami, H. Snaith, Science, Vol 338, pp 643 (2 Nov. 2012)

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