Research Center for Photovoltaics

High Stability and High Efficiency Perovskite Solar Cells

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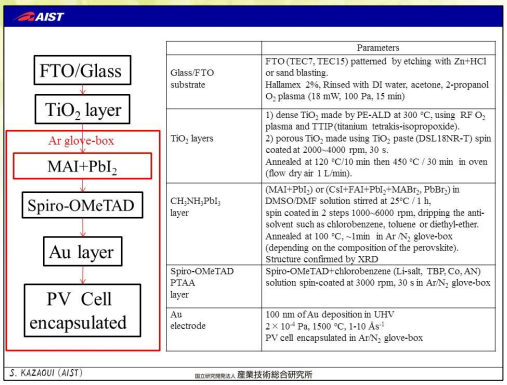
Introduction

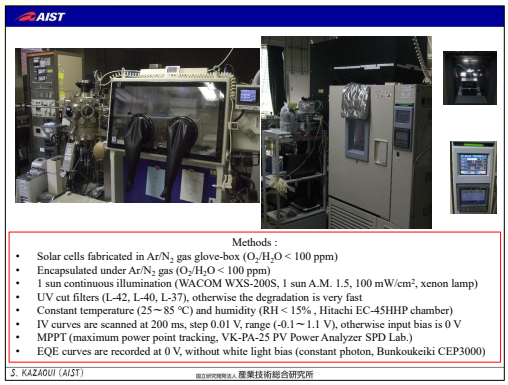
The demand for new materials in order to increase the efficiency and to reduce the cost has triggered our interest to study the "Organo-Lead Halide Perovskite" solar cells.

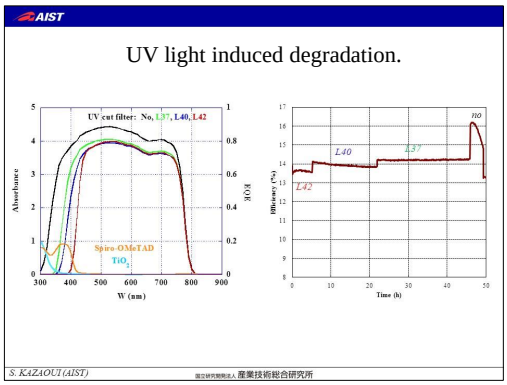
Goals

We compare the efficiency and the stability of $MAPbI_3$ and $(Cs,FA,MA)Pb(I,Br)_3$ Perovskite solar cells fabricated by wet solution process. MA is methylammonium ($CH_3NH_3^+$) and FA is formamidinium ($HN=CHNH_3^+$) cations.

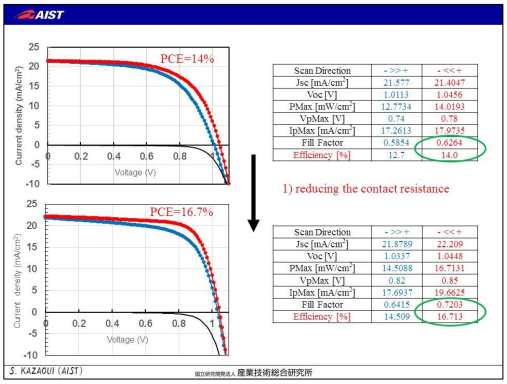
Methods

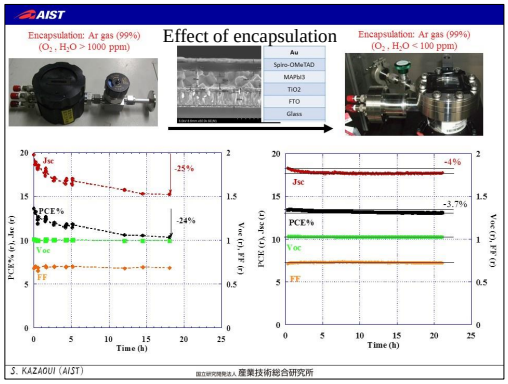


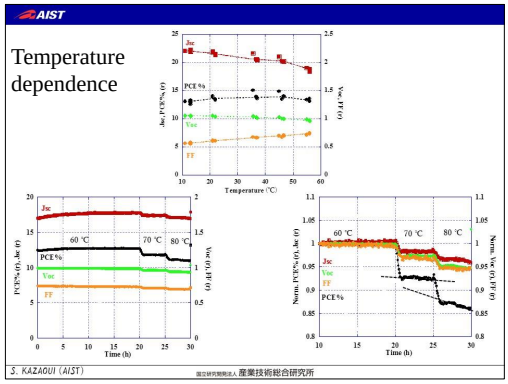




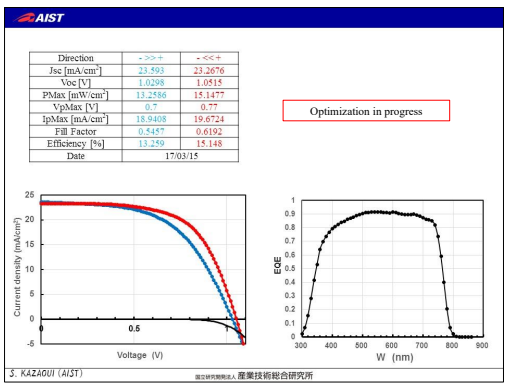
$MAPbI_3$ perovskite PVs

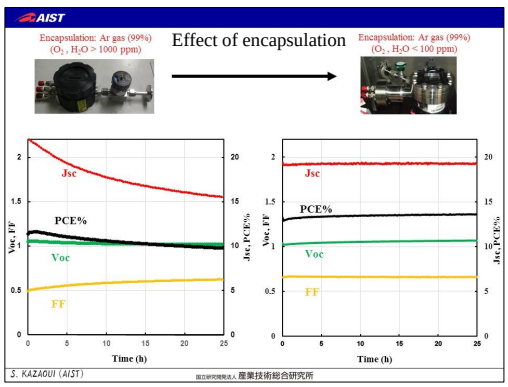


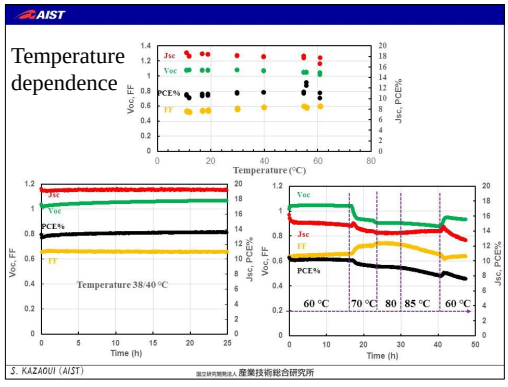




$(Cs,FA,MA)Pb(I,Br)_3$ perovskite PVs







Conclusions / Perspectives

1) Power conversion efficiency (PCE%) >15% was achieved with both $MAPbI_3$ and $(Cs,FA,MA)Pb(I,Br)_3$ PVs. To achieve high efficiency the optimization of the chemical composition of $(Cs,FA,MA)Pb(I,Br)_3$ PVs is in progress.

2) High stability is achieved for PVs fabricated and encapsulated in low level of O_2/H_2O < 100ppm (Ar glove box), but low stability for PVs fabricated in dry air (20% O_2, 5% RH) or encapsulated in high level O_2/H_2O > 1000 ppm.

3) Both $MAPbI_3$ and $(Cs,FA,MA)Pb(I,Br)_3$ PVs show a relatively high thermal stability up to 60 °C, but poor thermal stability above 70/80 °C.

Experiments are in progress to elucidate the origin (perovskite, hole and electron transport layers) and the mechanisms leading to the degradation of PVs.

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