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CHARACTERIZATION OF PEROVSKITE MINI-MODULES

AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

The main challenge for the successful commercialization of perovskite solar cells is to achieve high stability at the module level. The commercially available solar modules undergo a series of characterization procedures that analyze their properties and ensure their quality. Unfortunately, these procedures and protocols are not fully applicable to perovskite solar modules (PSM). To this end, more advanced characterization methods are needed to understand the degradation mechanisms in the PSM. The proposed work uses optical and electrical characterization methods to understand the degradation of perovskite mini-modules.

EXPERIMENTS

1. A - **double cation-double halide perovskite active layer** with the composition $Cs_{0.18}FA_{0.82}PbI_{2.82}Br_{0.18}$ was used. In order to make large-area devices, so called mini-modules (size: 2cm x 2cm) were produced by laser scribing, to generate 7 sub-cells connected in series.

Fig.1 shows the **structure of the perovskite sub-cell** and the cross-section of the mini-module.

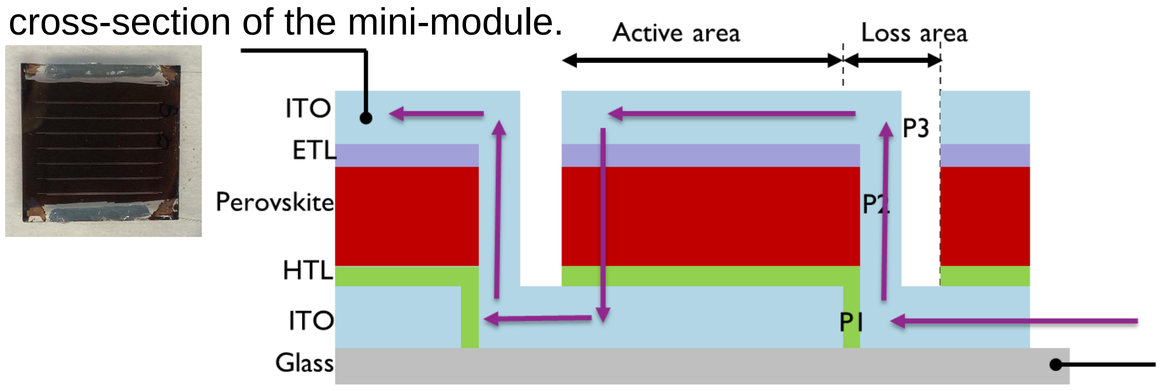

FIG.1 Cross-section of the mini-module.

RESULTS

Fig.2 shows the **EL images** of a mini-module (front side and back side) and **Table 1** the **IV-measurement** results.

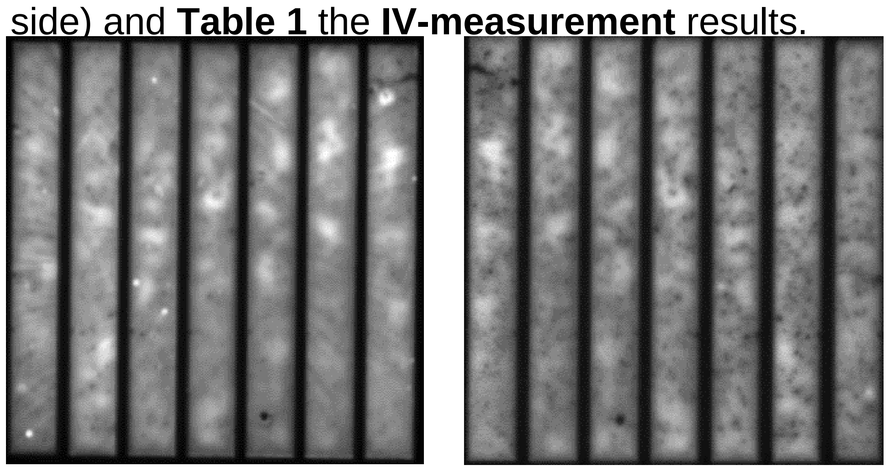

FIG.2 EL perovskite mini-modul: front side (left) und backside (right).

Table 1: IV measurement results

Voc [V]	Jsc [mA.cm^{-2}]	Pmax [mW]	FF [%]
7.789	13.1	34.29	42.91

IV measurements as well as EL measurements were performed regularly from **July 2021 to May 2023** to determine the **aging behavior** of the mini-modules. The modules were stored in the dark between measurements. As can be seen in **Fig.3**, the mini-modules behave very stable over this period. Only after some measurements (e.g. DLIT, Raman) there is sometimes a clear increase or decrease in power, partly reversible and also irreversible.

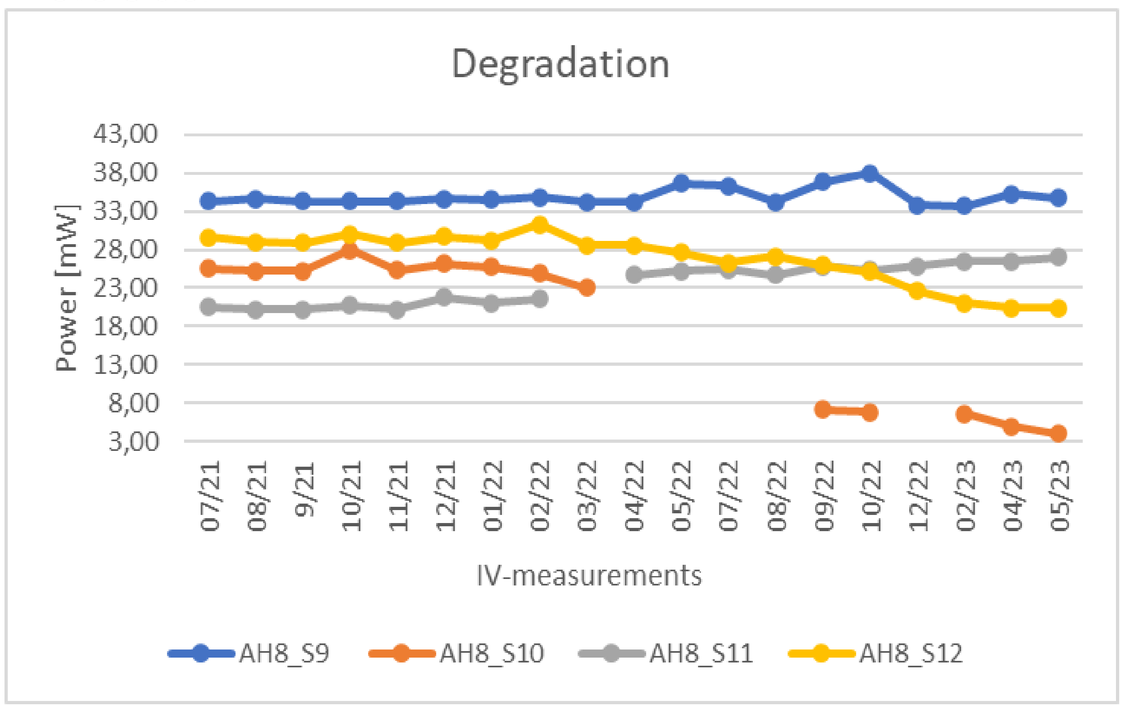

FIG.3 Aging behavior of the perovskite mini-modules

2. The perovskite solar cell stack consists of a **glass/ITO/HTL/perovskite/passivation layer/C_{60}/SnO_x/ITO/Ag finger** in p-i-n configuration. Encapsulated semitransparent perovskite solar cells were investigated, without edge sealer and with a mask used to define the aperture area taped on the front glass (cell size: 0.5mm x 0.5mm). See the sctructure of the samples in **Fig.4.**

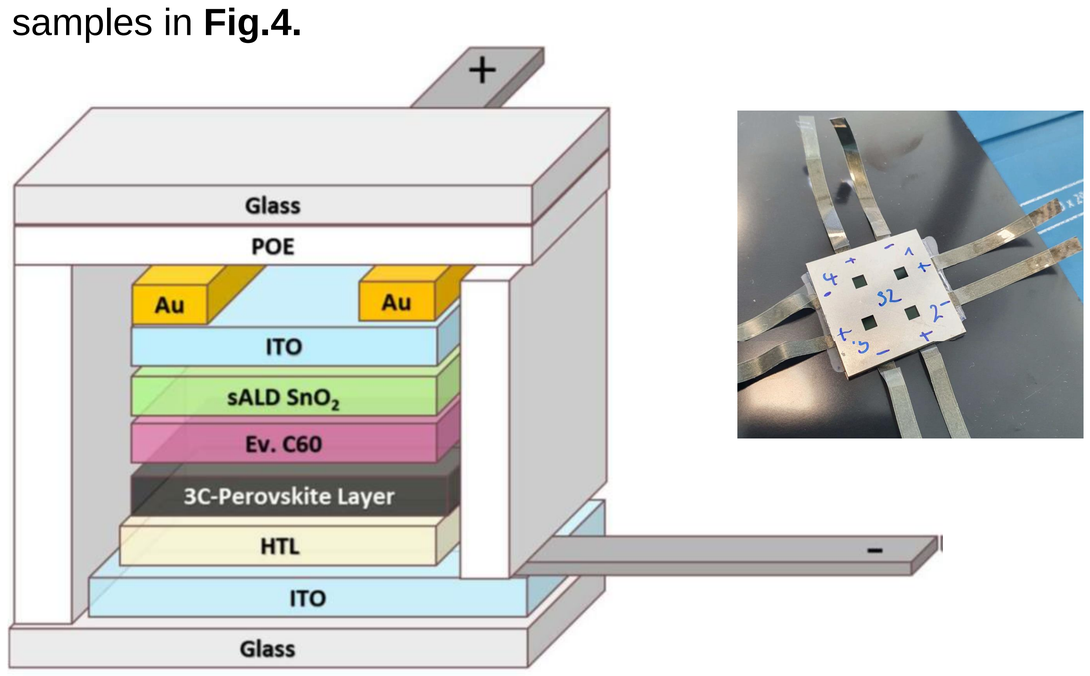

FIG.4 Structure of the pervskite cells.

RESULTS

Fig.5 shows the **EL images** of four perovskite-cells on Sample 2 (front side).**Table 2 shows** the **IV-** and **Fig.6** the **EQE** measurement results.

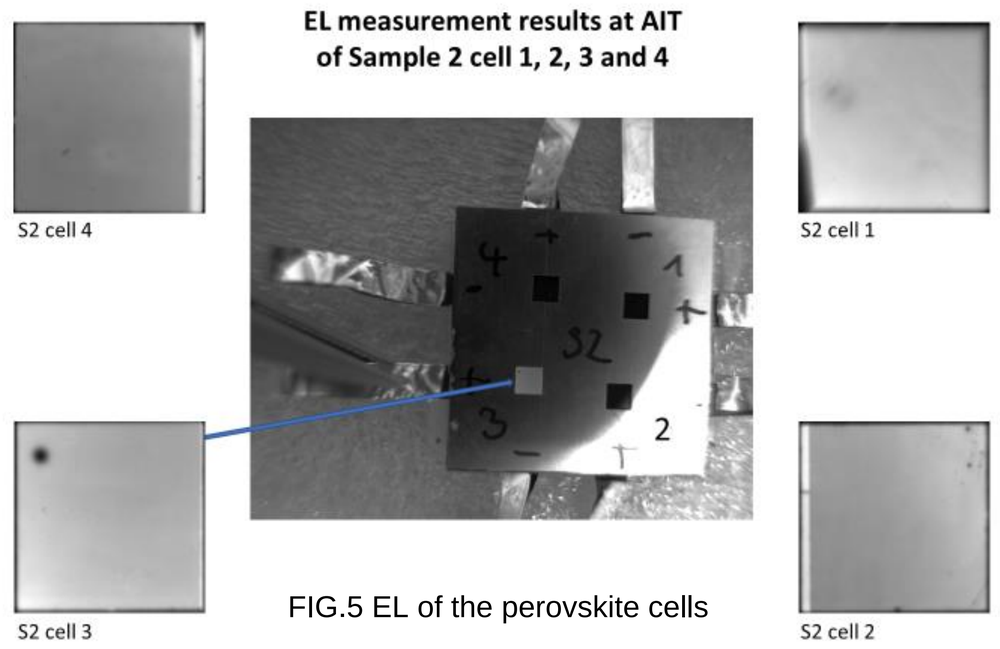

FIG.5 EL of the perovskite cells

Table 2: IV measurement results, cell 1, Sample 2

Voc [V]	Jsc [mA.cm^{-2}]	Pmax [mW]	FF [%]
1.117	19.94	16.8	72.65

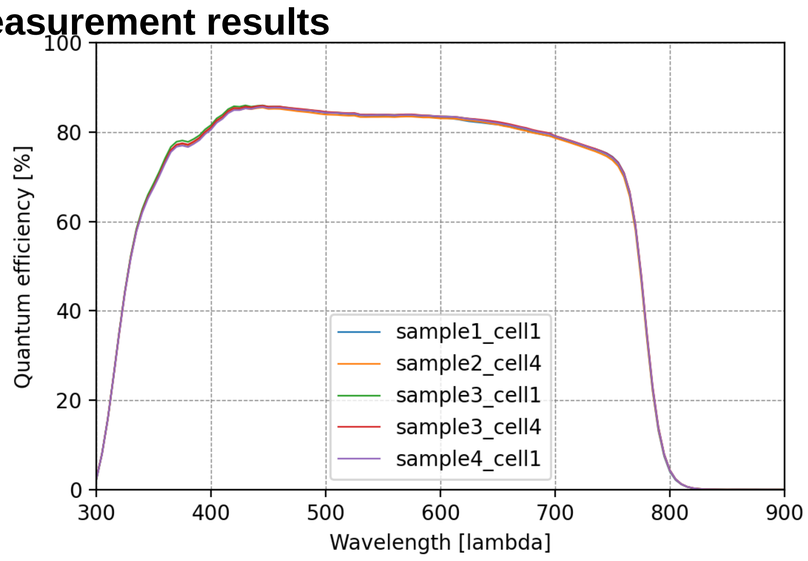

FIG.6 EQE of perovskite cells (different Samples and cells)

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