Title : Opto-electronic characterization of Perovskite module by electroluminescence imaging

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The photo- or electro-luminescence are versatile tools to investigate semiconductor materials or optoelectronic devices and many developments have occurred during the last decade. In PV modules characterization, one of the main difficulties is to separate the contribution of each constitutive cells. In this work, we show that the modelling of voltage-dependent electroluminescence allows to distinctly access the electrical properties of each subcells. Then, this technique associating modelling with voltage-dependent electroluminescence imaging helps understanding the contribution of each individual subcell in the loss of performance of the module. This technique is a powerful tool to support the optimization of perovskite based module identifying the origin of main drawbacks (scribing process, deposition processes…)

The perovskite based module we studied is composed of 4 cells connected in series with the classical P1-P2-P3 monolithic inter-connection. The voltage applied to the module is varied from Voc-0.4V to Voc+0.4V and the voltage-dependent EL curves for each subcell are calculated from EL images. Then a dedicated modelling of the EL of the module is developed to figure out the influence of the different electrical parameters of each subcell on the EL signal. We focus in particular on the relative intensity between the subcells when the voltage is varied. For example as the EL of each subcell is strongly influenced by their respective values of shunt resistance and recombination current, the series résistance seems to have influence only on the complete module. The performance of the module with various conditions of shunt resistance and/or recombination current is also analyzed.

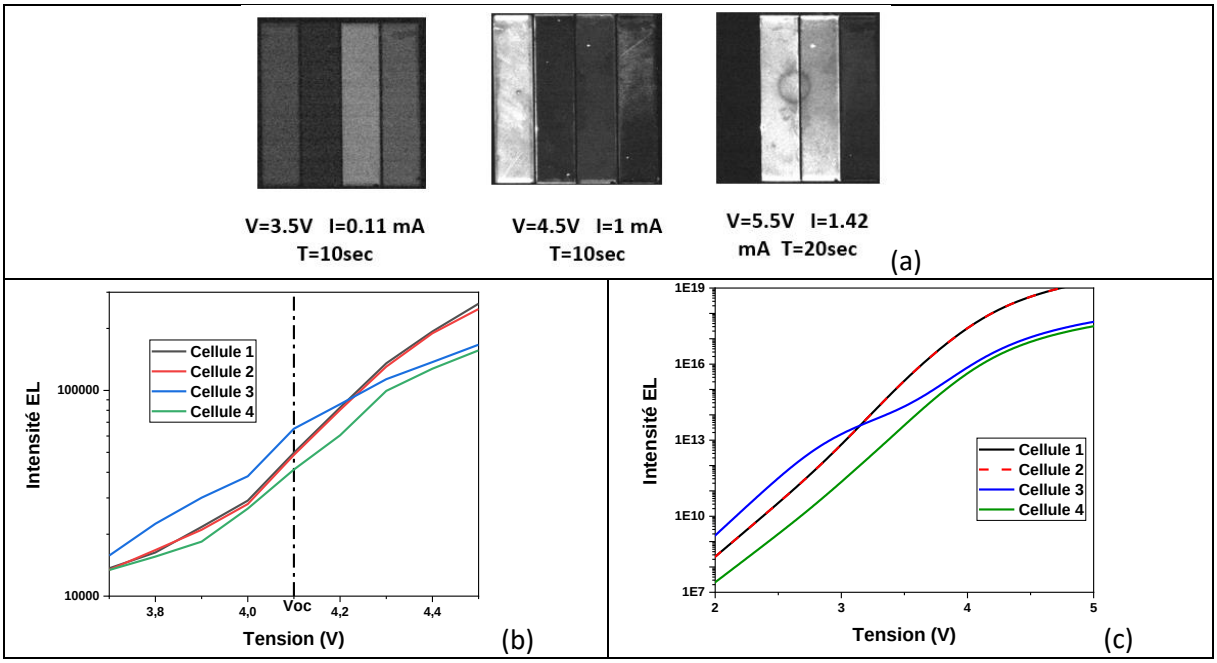

Figure 1. (a) Example of EL images of perovskite module at various voltages. (b) Voltage-dependent spatially average intensity of each of the 4 cells of the module. (c) Modelling of the EL(V) of the same cells.