CdSeTe solar cells: the positive impact of Se analyzed by high-resolution cathodoluminescence mapping

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Polycrystalline Cadmium Telluride (CdTe) thin-film solar cells have a very low levelized cost of energy and provide an attractive alternative to Si cells. However, their efficiency is still hindered by the presence of defects in grain interiors and at grain boundaries. Interestingly, it has been shown recently that the addition of Se in CdTe significantly improves the short-circuit current by bandgap lowering, but without open-circuit voltage (Voc) losses [1]. This positive impact of Se is attributed to a passivation effect [2,3].

In this work, we investigate a series of $CdSe_xTe_{1-x}$ samples with different concentrations of Se from x=0 to x=0.4. We present high-resolution cathodoluminescence mapping performed at both room- and low-temperature on the same area. The Se concentration gradient in each layer is monitored with the luminescence peak energy (fig 1b), and correlated to the CL intensity. We show that the radiative efficiency depends only on the peak position (Se concentration) and increases by one order of magnitude from CdTe to $CdSe_{0.4}Te_{0.6}$ (fig 1c). Low-temperature measurements at the same location provide insights in the defect energy and density (not shown). We will also present preliminary assessments of the internal radiative efficiency based on calibrated CL flux and temperature-dependent measurements.

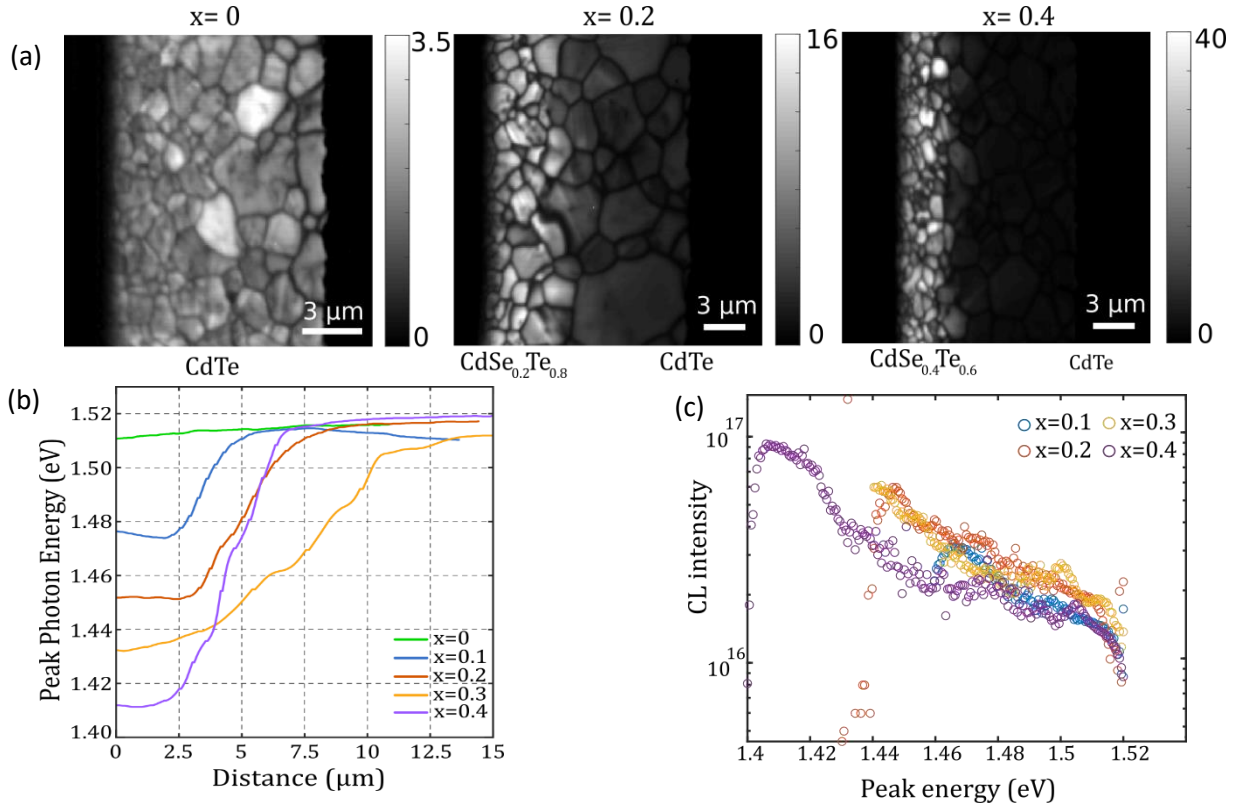

Figure 1 : CL intensity of CdSeTe sample with Se concentration ranging from 0 to 40%. (b) Peak photon energy as a function of distance from the CdSeTe/back contact interface along the surface. (c) Radiative efficiency as a function of the peak energy (logscale)

[1] J. D. Poplawsky *et al.*, *Nat. Commun.*, **7**, 1–10, 2016
[2] T. A. M. Fiducia *et al.*, *IEEE J. Photovoltaics*, **10,** 685–689, 2020
[3] T. A. M. Fiducia et al., *Nature Energy* **4**, 504-511, 2019