Efficient Energy Management in Hybrid Organic Silicon Solar Cell by Downshifting using Mn doped $CsPbCl_3$ QDs

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Abstract

The management of solar conversion by exploiting a wider regime of the solar spectrum was a key feature of many photovoltaics studies.[1] Spectral downshifting of highly energetic photons in the ultraviolet region was introduce previously in Luminescent solar concentrator technology to decrease the effect of thermalization in Si-related solar cells. Furthermore, the antireflection coating was used to decrease sunlight losses on the Si surface. Herein, we introduce novel hybrid organic (PEDOT: PSS)/inorganic (silicon nanotip) solar cells combined with Mn-doped $CsPbCl_3$ perovskite nanocrystals (NCs). This is the first report for the application of highly luminescent Mn-doped $CsPbCl_3$ perovskite NCs as downshifting functional materials. NCs of Mn doped $CsPbCL_3$ act as a radiative and nonradiative energy transfer centers.[2] This new energy transfer mechanism drastically enhanced the energy conversion efficiency from 10.6% to 13.4%.[2] The realization of highly efficient perovskite-based hybrid solar cells shows the potential application for the production of high efficiency, large-area, cost-effective and commercially feasible cell.

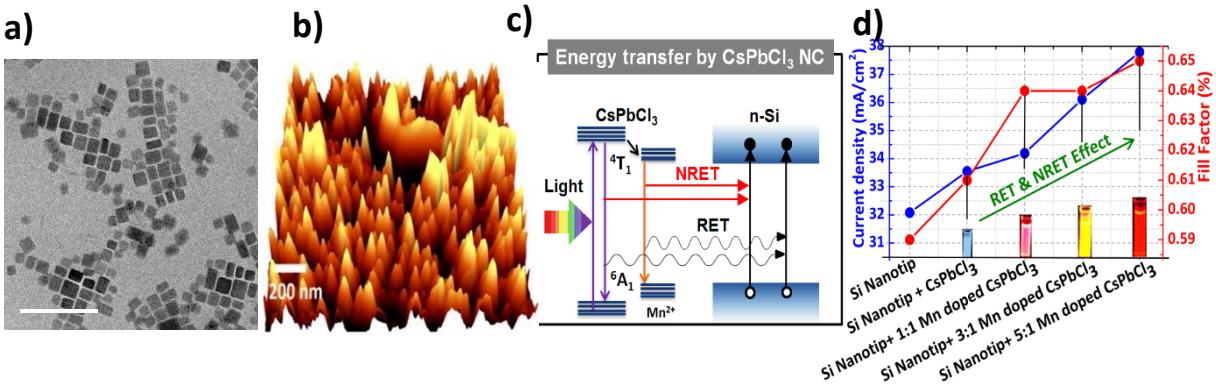

Figure1 a) TEM image of Mn doped $CsPbCl_3$ NCs (- 100 nm), b) AFM morphology of Si nanotips, c) Schematic band diagram of hybrid organic Si solar cell with Mn-$CsPbCl_3$ as a downshifting layer and d) the effect of PL spectral tuning and radiative & nonradiative energy transfer of Mn-$CsPbCL_3$ on the solar cell parameters.

References

1- T. Subramani, J. Chen, Y. L. Sun, W. Jevasuwan, W. and N. Fukata, *Nano Energy 35* (2017) 154.
2- Mostafa F. Abdelbar, Maged El-Kemary and Naoki Fukata, Nano Energy 77 (2020) 105163.