P13

Passivation effects on spectral properties of ytterbium doped cesium lead halide perovskites

Daniel Rodz[1], Simona Streckaitė[1], Vidmantas Gulbinas[1]

[1]*Department of Molecular Compound Physics, Center for Physical Sciences and Technology, Vilnius, Lithuania.*

Email: daniel.rodz@yahoo.com

Recently perovskites have shown to be promising materials in photovoltaics, where an efficiency of 26.1% was reached for non-tandem perovskite solar cells [1]. Doped perovskites, e.g. $CsPb_{1-1.5x}Yb_xCl_3$ are being explored not for the direct use in solar cells, but rather as efficient materials for luminescent solar converters. Such devices made from $CsPb_{1-1.5x}Yb_xCl_3$ efficiently down-converts one UV photon into two NIR photons, which has been shown to increase the efficiency of conventional Si solar cells [2,3].

In this work we apply a simple mechanosynthesis method for the preparation of ytterbium doped $CsPbCl_3$ powder exhibiting high NIR PLQY [4]. We also co-dope this powder with passivating ions (Mg^{2+}, Zn^{2+}, etc.), which should additionally improve quantum luminescence efficiency of Yb^{3+} [5]. We investigate how efficiently energy is transferred from the perovskite to Yb^{3+} ions and the influence of passivating ions by applying steady-state spectroscopy methods - fluorescence and absorption.

Co-doping was performed by mixing salts, e.g. $MgCl_2$, into the precursor materials or by adding it into the prepared Yb-doped perovskite powder. Prepared powder co-doped with Mg^{2+} shows slightly increased NIR PLQY, while the perovskite prepared with Yb^{3+} and Mg^{2+} shows a 20% improved NIR PLQY (Fig. 1, inset). This suggests that Mg^{2+} ions may decrease the number of vacancy defects and suppress trap-assisted nonradiative recombination. Interestingly, perovskite co-doped with Yb^{3+} and Mg^{2+} exhibits a second photoluminescence peak that is not present in other samples (Fig. 1, orange). It is yet unclear why this occurs.

We are also exploring the effects of other passivating materials and co-doping candidates, which may improve NIR PLQY further.

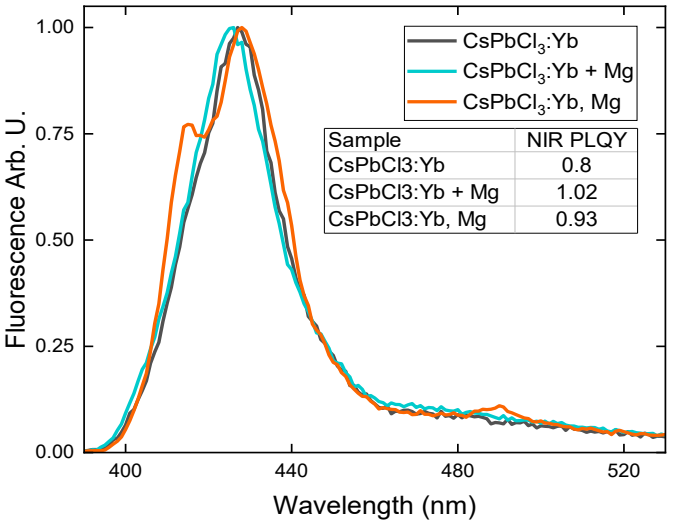

Fig. 1. Fluorescence spectra. Inset shows NIR PLQY of the samples.

REFERENCES

[1] Z. Liang, et al. Nature 2023, 624, 557.
[2] X. Luo, et al. Nano Lett. 2019, 19, 338.
[3] D. M. Kroupa, et al. ACS En. Lett. 2018, 3, 2390.
[4] S. Streckaitė, et al. J. Mat. Chem. 2023, 11, 15463.
[5] X. Sun, et al. J. Phys. Chem. Lett.2024, 15, 2665.