Enhancing of charge transfer efficiency from a perovskite $CH_3NH_3PbI_3$ film in a layer of titanium dioxide in the presence of Ag/SiO_2 nanoparticles.

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Using of localized plasmon resonance (LPR) in metal nanoparticles (NPs) is one of the promising directions for increasing of perovskite solar cells efficiency [1, 2]. Metal NPs coated dielectric shell can be used to exclude the contribution of the NPs to the total electrical conductivity of a perovskite films.

The influence of LPR in the "core-shell" NPs on the process of charge transfer from a perovskite $CH_3NH_3PbI_3$ layer to TiO_2 layer is studied in the work.

Samples with ITO−TiO_2−$CH_3NH_3PbI_3$ layers structure film were fabricated. Ti-Nanoxide BL/SC (Solaronix) paste were used for fabrication a compact TiO_2 layers. $CH_3NH_3PbI_3$ films synthesized by a one-step method [3]. 0.1 wt% Ag/SiO_2 NPs with respect to the mass of the perovskite was added to a solution of a $CH_3NH_3I•PbI_2•DMSO$ adduct in dimethylformamide. The diameter of Ag NPs was 5 nm, and the radius of the dielectric shell (SiO_2) was 2.5 nm.

The addition of NPs to the adduct solution leads to the formation of the perovskite films with a lower optical density than the perovskite without NPs. A decrease in the intensity of the luminescence, and a blue shift in wavelengths of the luminescence intensity maximum is observed for the $CH_3NH_3PbI_3$ films with NPs compared to this parameters for $CH_3NH_3PbI_3$ films without NPs. The luminescence lifetime also decreases for the $CH_3NH_3PbI_3$ with NPs. The intensity maximum of the luminescence kinetics for $CH_3NH_3PbI_3$ with NPs has a time delay (0.05 - 0.1 ns) in comparison with the maximum luminescence intensity of perovskite without NPs. These results indicate an increase in the efficiency of charge transfer from perovskite to TiO_2 in the presence of Ag/SiO_2 NPs.

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References

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