Magnetic Field Effects in Hybrid Perovskite Devices

C. ZHANG, D. SUN, C.-X. SHENG, Y. ZHAI, University of Utah, K. MIELCZAREK, A. ZAKHIDOV, University of Texas at Dallas, Z.V. VARDENY, University of Utah — Solar cells based on the organic-inorganic perovskites (CH$_3$NH$_3$PbX$_3$, X=halogen) have reached a remarkable power conversion efficiency approaching 20%, which calls for research studies of the photophysics behind this high device performance. We measured significant magneto-photocurrent (MPC) response in CH$_3$NH$_3$PbI$_{3-x}$Cl$_x$ photovoltaic cells, in the form of Lorentzian up to field $B = 1$T. We attribute the MPC($B$) response to spin mixing of loosely-bound photogenerated e-h pairs having different $g$-factor (dubbed “$\Delta g$ mechanism”). We verified this mechanism by measuring $\Delta g$ directly, using the field induced circularly polarized photoluminescence emission at low temperature, along with the photocarriers’ lifetime measured by picosecond pump-probe spectroscopy. We conclude that MPC of spin 1/2 e-h pairs provides a promising method for investigating the spin-related properties of photoexcitations in the novel hybrid perovskites.

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Date submitted: 10 Nov 2014