Abstract

Organic and metal halide perovskite solar cells and LEDs

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Pi-conjugated organic molecules and polymers now provide a set of well-performing semiconductors that support devices, including light-emitting diodes (LEDs) as used in smart-phone displays and lighting, field-effect transistors (FETs) and photovoltaic diodes (PVs). Management of transport and of excited state spin is fundamental for efficient LED and solar cells operation. I will discuss some of our recent work in Cambridge. I will discuss the use of spin ½ 'radical' semiconductors where we can light emission to the spin doublet excited state that avoid non-radiative spin triplet states [1,2].

Lead halide perovskites have been developed primarily for use in solar cells and now show remarkable levels of efficiency. These materials can be strongly luminescent, so that charge extraction can proceed at high cell voltages without significant recombination losses. This high luminescence yield can be exploited in LEDs. Light-emitting diodes based on halide perovskites have recently reached external quantum efficiencies of over 20 percent. One of the recent developments that has advanced the level of performance is the use of mixed two-dimensional and three-dimensional pervoskites, which allow very high luminescence yields from the three-dimensional phases [3].

References
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[2] Abdurahman et al., *Nature Materials* (2020) doi.org/10.1038/s41563-020-0705-9
[3] Zhao et al., *Nature Electronics* (2020) doi.org/10.1038/s41928-020-00487-4