New semiconductors and new architectures for LEDs and solar cells

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I will explore recent advances in two classes of thin-film semiconductors which show real promise for use in solar cells and LEDs

Thin film lead halide perovskites have evolved in the past 5 years to give solar cell efficiencies above 20%, and more surprisingly, to give extremely luminescence efficiencies in spite of the presence of very levels of defects and impurities that would severely limit performance in traditional inorganic semiconductors. I will explore the close relationship between luminescence and solar cell operation.

Pi-conjugated organic molecules and polymers now provide a set of well-performing semiconductors that support devices, particularly light-emitting diodes (LEDs) as used in smart-phone displays. The physics of organic semiconductors is often controlled by large electron-hole Coulomb interactions and by large spin exchange energies. Management of excited state spin is fundamental for efficient LED and solar cells operation. I will discuss recent progress in the control of emissive spin singlet excited states and non-emissive spin triplet excited states as exploited in both LEDs and in solar cells.