Spin-dependent photophysics: magnetic field Effects in organic materials

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Magnetic field effects can occur in organic materials through photophysics, leading to spin-dependent photophysics.[1] In principle, magnetic field effects require two necessary conditions: (i) an equilibrium on spin populations in excited states is established by the spin mixing from spin-orbital coupling and the spin conservation from exchange interaction and (ii) a magnetic field is able to disturb the equilibrium with the consequence of changing the spin populations. Normally, magnetic field effects can be readily observed in organic materials because the equilibrium on spin populations established by spin mixing and spin conservation can be easily disturbed by a magnetic field due to both negligible spin-orbital coupling and weak exchange interaction.[2,3,4] More importantly, magnetic field effects can reflect deeper spin-dependent processes in light-emitting, photovoltaic, and lasing actions. This presentation will first review the recent development of magnetic field effects on photophysics and then discuss how spin states can control light-emitting, photovoltaic, and lasing actions in organic materials.[5] First, the review will focus on spin-dependent photophysics processes in excited states and charge transport towards developing magneto-photoluminescence, magneto-current, and magneto-dielectrics. Specifically, the presentation will review the mechanisms on controlling spin mixing and spin conservation in excited states when magnetic field effects are generated in photophysics. Second, the presentation will discuss how magnetic field effects can reveal (i) spin-dependent processes in organic light-emitting didoes (TADF: Thermally Activated Delayed Fluorescence), (ii) the effects of spin states on photovoltaic properties in perovskite solar cells, and (iii) the cooperative excited states towards optical gain in lasing actions. In summary, magnetic field effects have become a powerful tool to investigate the deeper photophysics in organic materials.

References:

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