

Inorganic Photophysics: Singlet and Triplet States

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Shining light onto molecules is a unique approach to the synthesis of new excited state molecules that are highly energetic with unprecedented structures and reactivities. Such structures and reactivity are difficult to be obtained through examining the chemistry and reactivities of ground state molecules. The realization of the importance of electronic excited state molecules in bimolecular chemical reactions and molecular recognitions heavily relies on their lifetimes and concentrations in solutions upon irradiation with light. Directly probing the chemistry and photophysical processes of electronic excited state molecules depends on the availability of a spectroscopic handle for monitoring the excited state molecules. All these requirements can be readily met through investigating phosphorescent transition metal compounds that have long-lived and emissive excited states in solutions. Due to the heavy atom effect, phosphorescent transition metal compounds have emissive triplet excited states with sufficiently long lifetimes in solutions for bimolecular reactions to take place. The decay of the lifetime and/or intensity of the emission can serve as a probe for monitoring the excited state molecules. It should be noted that the emission quantum yield and excited state lifetime are strongly affected by non-radiative decay processes, which may be regulated through molecular design, that is, judicious choice of metal ions and auxiliary ligands.