

Ultrafast Spectroscopy of Photophysics and Photochemistry of Metal Complexes

(A Funfair for Molecular Physicists)

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Transition-metal complexes are molecular systems where a metal atom is bonded to different molecular groups to form a so-called coordination complex. In most of these systems the lowest electronic transitions correspond to metal-to-ligand charge-transfer states, where an electronic charge is well localized on the ligand with the lowest empty states. These transitions are typically centred in the visible and, as well as several physicochemical properties (solvent-solute interaction, radiative and non radiative intramolecular relaxation mechanisms, vibrational density of states, etc.) can be easily tuned with a suitable choice of the central metal atoms and the ligands. This provides a well localized electron upon visible light excitation, ready to be used for a variety of photophysical and photochemical processes. Metal-based complexes have indeed found a broad range of applications, as diverse as light energy conversion, development of opto-magnetic data storage and processing devices, homogeneous photocatalysts at room temperature, conductive polymers.

In the last years we and other groups have employed and implemented several femtosecond time-resolved electronic spectroscopies to understand at a more fundamental level which dynamical and structural parameters play a role in the dynamics and relaxation processes occurring in the excited states. Indeed the capability of ultrafast spectroscopic techniques to follow these processes in real time along with the possibility to finely modulate several molecular properties of these complexes (as spin-orbit coupling strengths, energy structure, electronic delocalization, etc) has allowed us to shine new light on the mechanisms of inter-system crossing, redistribution and dissipation of vibrational energy, the role of the environment on the formation of charge localized state.

In this talk my recent research activity in this field will be presented and an outlook over the near future research will be given.