MCD OF CRYSTALLINE THIN FILM ORGANIC SEMICONDUCTORS

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Metal Phthalocyanines (MPc's) are organic p-type semiconductors used in light emitting diodes (LEDs), photovoltaic cells and field effect transistors (FETs). In the crystalline phase, they exhibit large mobilities (~1cm^2/Vs) and can also accommodate magnetic ions such as Cu, Co, or Mn in the center, making them exhibit paramagnetic and even ferromagnetic behavior [1]. Soluble organic thin films allow engineering of magnetic properties via control of the molecular stacking and possible creation of the organic analogues to diluted magnetic semiconductors (DMS) [2].

Magnetic Circular Dichroism (MCD) is extremely useful in understanding the correlations between excitons, spin exchange mechanisms and collective magnetic behavior of conduction electrons [3]. We investigated these exchange mechanisms in long range ordered crystalline MPc thin films. Non peripheral substituted Cobalt and Manganese Pc's were fabricated using a novel solution-based pen-writing technique [4]. MCD of Co-Pc shows signature of distinct transitions between ligand electronic states in the vicinity of the bandgap (fig 1a). The evolution of Zeeman splitting of specific MCD-active states is very well described by a Brillouin-like function with enhanced effective g-factors (fig 1b), analogous to DMS systems. MCD active states beyond 1µm have been observed for the first time in case of MnPc thin films (fig 1c). In the case of Mn-Pc, our measurements show stronger hybridization of ligand electronic states with the Mn d-orbitals. Future plans involve MCD experiments in high magnetic field at the NHMFL's new B=25T Split-Helix magnet facility [5] and SQUID measurements at the IFPAN, Poland.

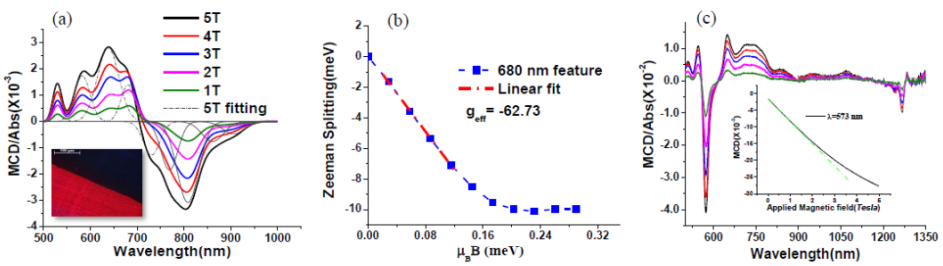

Fig. 1**: a)** MCD spectra of Soluble Co-Octabutoxy Pc with varying magnetic field up to 5T. Inset: Polarized image of thin film sample showing long range order (dark and bright grains correspond to different grain orientations, scale bar=0.5mm) **b)** Zeeman splitting of ligand electronic state (λ = 680nm) as a function of magnetic field. **c)** MCD spectra of Mn-Octabutoxy Pc with varying magnetic field up to 5T, Inset: field ramp at 573nm showing non linear evolution of MCD with increasing magnetic field.

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