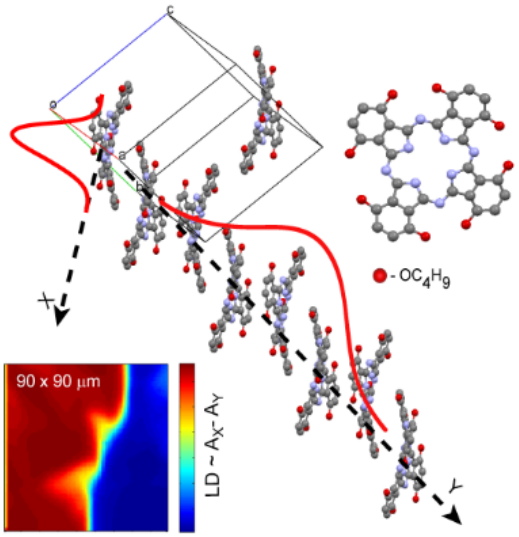
Exciton Delocalization and Magnetic Interactions in Crystalline Organic Thin Films

Madalina Furis

Associate Professor and Materials Science Program Director
Physics Department, University of Vermont



Organic electronics, an interdisciplinary research area traditionally more connected to organic synthetic chemistry and polymer science than condensed matter physics, is currently undergoing a major transformation. The advent of high mobility small molecule semiconductors and new avenues for scalable thin film and device fabrication introduce a new paradigm in a research field that was historically overwhelmingly focused on polymer-based materials.

At the University of Vermont my research group focuses on exploring excitonic states, low temperature magnetism and spin-dependent exchange interactions in metal and metal-free octabutoxy phthalocyanine (OBPc) crystalline semiconducting thin films that belong to an intermediate regime between a fully localized (Frenkel) and fully delocalized (Wannier) picture of the excitonic behavior. We employ condensed matter experimental approaches (in particular low temperature, polarization-resolved, ultrafast, magneto-spectroscopy) on a quest for signatures of long range interactions such as exciton-phonon coupling and spin exchange in these systems. Recent results include: i) the observation of a low temperature nominally “dark” exciton state that is now optically-allowed because intermolecular interactions led to a breakdown of the selection rules,[1] ii) the surprising discovery of excitonic states localized at the grain boundary that provides new insight on exciton diffusion in these systems,[2] and iii) the direct observation of an MCD signature of an exchange between d-shell electrons of the metal ion and the delocalized π-orbitals of the ligand in transition metal species of MOBPc.[3]

1. Rawat, N., et al. J.Phys. Chem. Lett. 2015, **6**(10), 1834-1840.
2. Pan, Z., et al. Nat.Commun. 2015, **6**.
3. Rawat, N., et al., Sci. Rep. 2015, **5**, 16536.

Email Contact: Madalina.Furis@uvm.edu

CV and Bio available at: www.uvm.edu/~mfuris