Spin polarization in molecules

Georgeta Salvan[1,2]

[1]Semiconductor Physics, Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany
[2]Center of Materials, Architectures and Integration of Nanomembranes, Chemnitz University of Technology, 09126 Chemnitz, Germany

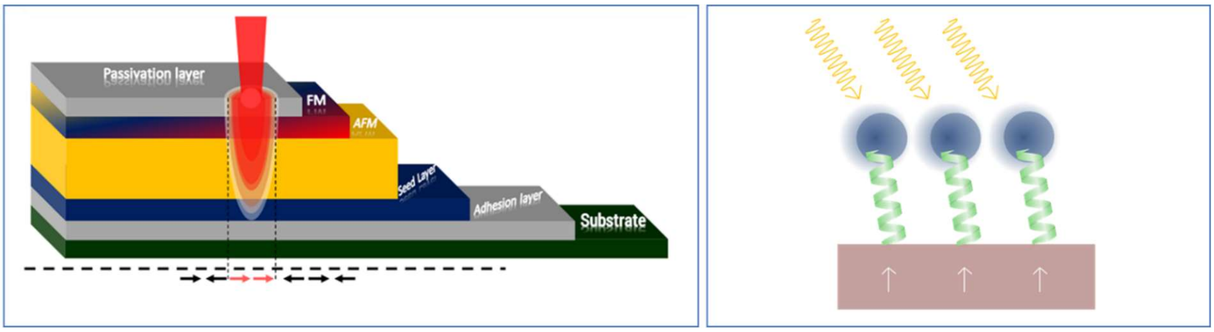
salvan@physik.tu-chemnitz.de,

HYP*MOL is a German research network on hyperpolarization in molecular systems that started on 1st October 2023.

Electrons and many atomic nuclei carry not only electric charge, but also a magnetic moment called “spin”. The controlled realization of a transient spin order of electrons or magnetic nuclei, i.e., of hyperpolarization, in molecular systems is expected to have a major impact in three research areas of chemistry and physics, namely magnetic resonance, spintronics and spin-chemistry with implications towards practical applications for example in medicine, multifunctional electronics, or high-yield catalysis. The TRR HYP*MOL will contribute to the fundamental understanding of generation of electronic and nuclear spin hyperpolarization, its transport through molecular structures and its control.

The Magneto-Optics group in Chemnitz employs magneto-optical spectroscopies and magneto transport for charactering the spin polarization.

Magneto-optical (MO) spectroscopies in the near-infrared to ultraviolet spectral range offer access to the joint density of states involving valence states in various diamagnetic, paramagnetic, and magnetically ordered systems. The extraction of the individual MO response of materials and/or nanostructures in complex systems is challenging, but accessible via experimental and/or numerical simulation or fitting approaches. Thanks to the excellent sensitivity of the current magneto-optical Kerr effect (MOKE) spectrometers the characterization of ultra-thin ferromagnetic layers with thicknesses in the sub-nanometer range, thin paramagnetic and diamagnetic molecular layers, organic/ferromagnetic heterostructures, or superparamagnetic clusters in organic matrices or other complex heterostructures became possible [1]. I will review our work on MOKE spectroscopy applied to spin polarization at organic/inorganic interfaces [2], tunnelling magnetoresistance junctions [3] and garnets [4].



Schematic representation of the laser annealing process for a TMR junction (left) and of the optically induced chirality induced spin selectivity effect in a hybrid organic/inorganic layer stack (right)

[1] A. Kimel, A. Zvezdin, S. Sharma, S. Shallcross, N. De Sousa, A. Garcia-Martin, G. **Salvan**, et al. “The 2022 magneto-optics roadmap” Journal of Physics D: Applied Physics, 55, 463003 (2022)
[2] A. Sharma, **G. Salvan** et al. Phys. Rev. B 101, 054438 (2020).
[3] A. Sharma, **G. Salvan** et al., J. Mater. Chem. C, 8, 11822—11829 (2020)
[4] A. Sharma, **G. Salvan** et al., Appl. Res. E202200064 (2023), DOI: 10.1002/appl.202200064