Helical Molecules and Electron Spin

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For spintronic applications the development of a source of spin polarized electrons operating at room temperature is still a challenge. A new approach proposed by Ron Naaman is based on the interaction of electrons with ordered chiral molecules. Early experiments using circularly polarized light to emit photoelectrons from gold surfaces transmitting through monolayers of stearoyl lysine [1] and DNA [2] indicated a spin-filtering behavior of such organic layers.

Results on the electron spin polarization observed for various samples of self-assembled monolayers of helical molecules on metal and semiconductor surfaces are presented. Samples are irradiated with circularly and linearly polarized laser radiation at $\lambda = 213$nm to generate photoelectrons in a single step. The spin orientation of the photoelectrons is analyzed by a Mott polarimeter. Longitudinal spin polarizations of up to about 60% have been measured in case of oligo dsDNA, irrespective of the polarization of the irradiating light [3]. Experiments with chiral membrane proteins and self-assembled monolayers of α-helical oligo-peptides show also spin filtering properties [4]. Similar to DNA a dependence of the spin polarization on the length of the molecules is observed. Recent experiments with helicene show that the direction of the electron spin polarization is coupled to the helicity of the molecules.

[1] K. Ray et al., Science **283**, 814 (1999)
[2] S.G. Ray et al., Phys. Rev. Lett. **96**, 036101 (2006)
[3] B. Göhler et al., Science **331**, 894 (2011)
[4] M. Kettner et al., J. Phys. Chem. C **119**, 14542 (2015)