

Allgemeines Physikalisches Kolloquium

Donnerstag, 14.05.2020 um 16 Uhr c.t.

Online-Kolloquium

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The electron spin and chiral systems-Merging that results in novel properties

Spin based properties, applications, and devices are commonly related to magnetic effects and to magnetic materials. However, we found that chiral molecules act as spin filters for photoelectrons transmission, in electron transfer, and in electron transport. The spin polarization can exceed 85% at room in some systems.

The new effect, termed Chiral Induced Spin Selectivity (CISS),^{1,2} was found, among others, in bio-molecules and in bio-systems. It has interesting implications for the production of new types of spintronics devices^{3,4} in controlling magnetization,⁵ and on electron transfer and conduction. It was also found that charge polarization in chiral molecules is accompanied by spin polarization. This finding shed new light on spin dependent interaction between chiral molecules and between them and magnetic surfaces.⁶

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[²] Spintronics and Chirality: Spin Selectivity in Electron Transport Through Chiral Molecules, R. Naaman, D. H. Waldeck Ann. Rev. Phys. Chem., **66**, 263 (2015).

[³] Magnetization switching in ferromagnets by adsorbed chiral molecules without current or external magnetic field, O. Ben Dor, S. Yochelis, A. Radko, K. Vankayala, E. Capua, A. Capua, S.-H. Yang, L. T. Baczewski, S. S. P. Parkin, R. Naaman, and Y. Paltiel, Nat. Comm., 8:14567 (2017).

[⁴] A new approach towards spintronics- spintronics with no magnets, K. Michaeli, V. Varade, R. Naaman, D. Waldeck, Journal of Physics: Condensed Matter, **29**, 103002 (2017).

[⁵] E. Z. B. Smolinsky, A. Neubauer, A. Kumar, S. Yochelis, E. Capua, R. Carmieli, Y. Paltiel, R. Naaman, K. Michaeli, Electric field controlled magnetization in GaAs/AlGaAs heterostructures-chiral organic molecules hybrids, J. Phys. Chem. Lett. **10**, 1139–1145 (2019).

[⁶] Separation of enantiomers by their enantiospecific interaction with achiral magnetic substrates, K. Banerjee-Ghosh, O. Ben Dor, F. Tassinari, E. Capua, S. Yochelis, A. Capua, S.-H. Yang, S. S. P. Parkin, S. Sarkar, L. Kronik, L. T. Baczewski, R. Naaman, Y. Paltiel, Science **360**, 1331 (2018).