

# Chiral Molecules and the Electron's Spin- From Spintronics to Enantio-Separation

Ron Naaman,  
Department of Chemical and Biological Physics  
Weizmann Institute, Rehovot 76100, Israel

Spin based properties, applications, and devices are commonly related to magnetic effects and to magnetic materials. However, we found that chiral organic molecules act as spin filters for photoelectrons transmission,<sup>1</sup> in electron transfer,<sup>2</sup> and in electron transport.<sup>3</sup>

The new effect, termed Chiral Induced Spin Selectivity (CISS),<sup>4,5</sup> was found, among others, in bio-molecules and in bio-systems. It has interesting implications for the production of new types of spintronics devices<sup>6,7</sup> and on electron transfer in biological systems.<sup>8</sup> Recently we found that charge polarization in chiral molecules is accompanied by spin polarization.<sup>9</sup> This finding shed new light on enantio-specific interactions and it opens the possibility to construct novel methods for enantio-separation.

## References:

- [1] Göhler, B.; Hamelbeck, V.; Markus, T.Z.; Kettner, M.; Hanne, G.F.; Vager, Z.; Naaman, R.; Zacharias, H. *Science* **2011**, 331, 894.
- [2] Mishra, D.; Markus, T.Z.; Naaman, R.; Kettner, M.; Göhler, B.; Zacharias, H.; Friedman, N.; Sheves, M.; Fontanesi, C. *PNAS*, **2013**, 110, 14872.
- [3] Xie, Z.; Markus, T. Z.; Cohen, S. R.; Vager, Z.; Gutierrez, R.; Naaman, R. *Nano Letters*, **2011**, 11, 4652.
- [4] Naaman, R.; Waldeck, D.H. *J. Phys. Chem. Lett.* (feature) **2012**, 3, 2178.
- [5] R. Naaman, D. H. Waldeck, Spintronics and Chirality: Spin Selectivity in Electron Transport Through Chiral Molecules, *Ann. Rev. Phys. Chem.* **2015**, 66, 263–81.
- [6] 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.* **2017**, 8:14567.
- [7] K. Michaeli, V. Varade, R. Naaman, D. Waldeck, *Journal of Physics: Condensed Matter*, **2017**, 29, 103002.
- [8] I. Carmeli, K. S. Kumar, O. Hieflero, C. Carmeli, R. Naaman, *Angew. Chemie* **2014**, 53, 8953.
- [9] A. Kumar, E. Capua, M. K. Kesharwani, J. M. L. Martin, E. Sitbon, D. H. Waldeck, R. Naaman, *PNAS*, **2017**, 114, 2474.