Chiral-molecules based simple spin devices

Prof. Yossi Paltiel

paltiel@mail.huji.ac.il Applied Physics Department Chair The Rachel and Selim Benin School of Computer Science and Engineering Center for Nanoscience and Nanotechnology The Hebrew University, Jerusalem 91904, Israel

Abstract

With the increasing demand for miniaturization, nano-structures are likely to become the primary components of future integrated circuits. Different approaches are being pursued towards achieving efficient electronics, among which are spin electronics devices (spintronics). In principle, the application of spintronics should result in reducing the power consumption of electronic devices. A new, promising, effective approach for spintronics has emerged using spin selectivity in electron transport through chiral molecules, termed Chiral-Induced Spin Selectivity (CISS). Studying the CISS effect it was found that chiral molecules, and especially helical ones, can serve as very efficient spin filters.[1,2,3]

Recently, by utilizing this effect we demonstrated a magnet less spin based magnetic memory.[4] The presented technology has the potential to overcome the limitations of other magnetic-based memory technologies to allow fabricating inexpensive, high-density universal and embedded memory-on-chip devices. Another option is to achieve local spin-based magnetization generated optically at ambient temperatures[5], as well as local charge separation using a light induced configuration[6].

Biography

Professor Yossi Paltiel is now the Applied Physics Department chair in the Hebrew University of Jerusalem Israel. Prof. Paltiel has worked for both leading high-tech industry groups and in the academic world. Since July 2009, He is the leading the Quantum Nano Engineering group at the Hebrew University, Israel. Paltiel's group's goal is to establish a way to incorporate quantum mechanics into room temperature "classical" computation and reading schemes. This will provide quantum coherence control at nanometer scale distances, while maintaining the physical characteristics of currently available computer input-output devices. Professor Paltiel has published more than 70 papers in leading journals as well as issued 10 patents. Since 2013 professor.

Paltiel has a startup company named Valentis Nanotech. The company utilizes nanocellulose unique properties to produce a biodegradable transparent sheet with additional controlled optical and gas/water barrier properties. The sheets properties are controlled by introducing nano-crystals dispersed within the nanocellulose C layers. The mechanical properties of the NCC coated plastic sheets were shown to be significantly improved, without being compromised by the nanocrystals addition.

[1] B. Göhler,V. Hamelbeck, T.Z. Markus, M. Kettner, G.F. Hanne, Z. Vager, R. Naaman, H. Zacharias, "Spin Selectivity in Electron Transmission Through Self-Assembled Monolayers of dsDNA" *Science* **331,** 894-897 (2011).

[2] Z. Xie, T. Z. Markus, S. R. Cohen, Z. Vager, R. Gutierrez, R. Naaman, "Spin specific electron conduction through DNA oligomers" *Nano Letters*, **11**, 4652–4655 (2011).

[3] R. Naaman, D. H. Waldeck "The Chiral Induced Spin Selectivity Effect" *J. Phys. Chem. Lett*. (feature) **3,** 2178−2187 (2012).

[4] O. Ben Dor, S. Yochelis, S. P. Mathew, R. Naaman, and Y. Paltiel "A chiral-based magnetic memory device without a permanent magnet" *Nature Communications* **4**, 2256 Highlighted in *Nature Nanotechnology*: "A memory device with a twist" 7.8.2013 http://www.natureasia.com/en/research/highlight/8613

[5] O. Ben Dor, N. Morali, S. Yochelis and Y. Paltiel "Local Light-Induced Magnetization Using Nanodots and Chiral Molecules" *Nano Letters* **14** 6042 (2014).

[6] N. Peer, I. Dujovne, S. Yochelis, and Y. Paltiel "Nanoscale Charge Separation Using Chiral Molecules" *ACS Photonics*, **DOI:** 10.1021/acsphotonics.5b00343 (2015).