Philippe Lafarge, J Phys Chem Biophys 2014, 4:5
http://dx.doi.org/10.4172/2161-0398.S1.006

OMICS Group Conferences
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2nd International Conference and Exhibition on
Lasers, Optics & Photonics
September 08-10, 2014 Hilton Philadelphia Airport, USA

Quantum interference effects and molecular electronics

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Quantum interference is a hallmark of quantum mechanics with applications in optics, quantum computing, super conductivity. The ability to control this effect at the molecular level is a recent development of molecular electronics that could improve knowledge and control of electron transport through molecular systems. Cross-conjugated molecules, such as anthrax quinone, can behave as molecular quantum interferometers where the interference is due to different paths through the molecular orbital's of the molecule. The signature of quantum interference in molecular system is an antiresonance in the electron transmission function resulting in a strong suppression of conductance. In such systems, it becomes possible to tune the conductance over orders of magnitude by chemical design.

We will review recent results demonstrating the importance of destructive quantum interference in various molecular junctions and we will show our measurements of the differential conductance of anthraquinone layers electrochemically grafted in large-area junctions. We have found direct experimental evidence of a large quantum interference effect visible at room temperature with a strong enhancement at low temperature. The visibility and robustness of this quantum effect on large area junction paves the way for the development of practical devices based on the control of the coherent electron transport through cross-conjugated systems. Finally, enhancement of thermoelectric effects by quantum interference in two terminal molecular junctions will also be presented.

Biography

Philippe Lafarge has completed his PhD at the age of 26 years from Paris 6 University at CEA and postdoctoral studies from Delft University of Technology. In 1997, he joined the high magnetic field laboratory at the University of Grenoble, France. Since 2003, he is professor at University Paris Diderot in Paris. His current research interests are molecular electronics and spintronics and quantum transport through low dimensional carbon nano structures.

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