# Molecular spintronic devices

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The impending need of device miniaturization in microelectronics has inspired the idea of using a single molecule or a few molecules at most as a functional element in an electronic device. The controlled transport of electrons through organic molecule(s) sandwiched between two conducting electrodes has been the central theme of molecular electronics. The tunneling electrons essentially have two degrees of freedom, namely, charge and spin. If ferromagnetic electrodes are used, the conduction electrons experience a lower resistance when the relative orientation of the magnetizations in two electrodes is aligned in parallel (on state) than in anti-parallel (off state). This is the so-called spin-valve effect or magnetoresistive effect. Such a device can work as a switch, or a bit with on and off states. The availability of virtually unlimited number of organic molecules, each with unique electronic property offers intriguing possibilities in controlling the spin polarized current via molecules or monolayer for potential application in molecular spintronics. However, to date, most experiments involving tunneling measurements and theory on molecular devices have been concerned with the charge state of the electron. As a result, many open questions remain. Especially the role of the molecule and the effect of the molecule-electrode interface need to be fully understood before one can develop molecular devices for specific applications.

In this talk, I will present the results of a theoretical study of spin-dependent tunneling between a magnetic tip and a self-assembled organic monolayer-magnetic substrate with a goal to understand the role of the organic molecules on electron transport. I will also present results from our first-principles calculations on the spin-polarized electron transport in a two-terminal Ni-C60-Ni device where the fullerene molecule is bonded by atomic-scale ferromagnetic nickel contacts. The high magnitude of junction magnetoresistance revealed for the Ni-C60-Ni device makes it a promising candidate for realistic applications in molecular spintronics.