Optoelectronic properties of single conductive oligomers and graphen nano-ribbons.

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Electronic and optoelectronic properties of nanoscale one-dimensional structures such as carbon nanotubes, graphene nano-ribbons (GNRs) or conjugated polymers are central to many fundamental and applied studies. In recent years, new methods have enabled atomic-scale studies of organic 1D structures with scanning tunneling microscope. Based on an on-surface polymerization approach[1], these studies have revealed fascinating aspects of GNRs[2] and of various other molecular wires[1,3]. We showed that the electronic structures of short linear polymers (or oligomers) of thiophene could be approximated by a (nearly) free electron gas confined to a 1D box, while nano-rings made of the same material revealed unexpected electronic resonances[4]. We then studied the electroluminescent properties of suspended polythiophene wires suspended between a metallic surface and the tip of our STM, and discovered that this molecular junction behaves as a single-molecule LED[5].

The aim of the PhD project is to extend these study to organic polymers having specific properties. The first step will consist in probing the electronic and optoelectronic GNRs of different widths synthesised on a metal surface. This should allow the first electroluminescent measurments of an individual GNR. Other highly conjugated ribbons based on porphyrins and thiophene building blocks will also be probed following this approach. As a next step, donor-acceptor (D-A) copolymers will be probed with the aim of generating electron-hole recombinations at the D-A interface.

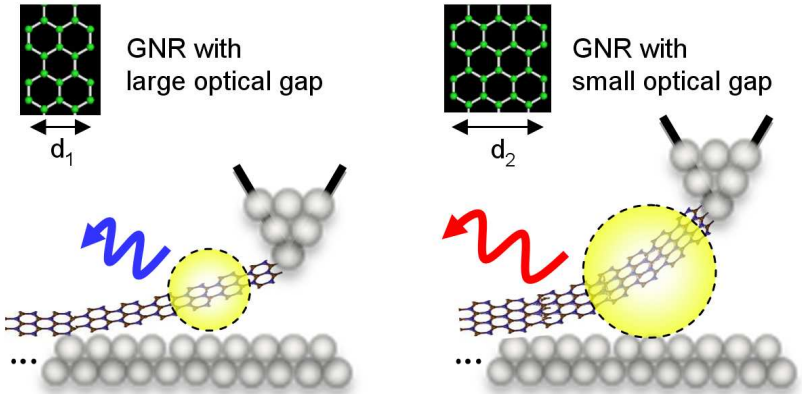

Figure 1: Probing the electroluminescence of individual GNRs as a function of their widths.

References:
[1] Lafferentz *et al.* Science **323**, 5918 (2009).
[2] Koch *et al.* Nature Nanotech. **7**, 713 (2012).
[3] Wang *et al.* Phys. Rev. Lett. **106**, 206803 (2011).
[4] Reecht *et al.* Phys. Rev. Lett. **110**, 056802 (2013).
[5] Reecht *et al.* Phys. Rev. Lett. **112**, 047403 (2014).