WIRING CONJUGATED POLYMERS AND BIOMACROMOLECULES

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Biological systems give inspiration for selfassembly of materials, and indeed tools for materials selfassembly on the nanoscale.. Polyelectrolyte complexes formed between natural polyelectrolytes, biomacromolecules such as DNA, peptides and proteins, and synthetic conjugated and luminescent polyelectrolytes (CPE) can be used to build nanostructures and materials combining the properties of the two classes of macromolecules. The assembly process may include all of the biological specificity of biomolecules, and therefore serve also as labelling and individualisation elements. We have shown [1] that complexes formed between a synthetic conjugated polyelectrolyte POWT and oligonucleotides, 10-25 bases long, or long chain DNA inducing excimer emission from POWT, recorded as a colour change in visible emission and absorption. Recognition of complementary oligonucleotide chains cause a reduction of the excimer emission, and is recorded as a colour change towards lower wavelength. This biospecific recognition is due to geometrical changes in the complex. We have also shown that similar changes may be recorded upon complexation between POWT and a synthetic polypeptide, a sign of the formation of a bundle of four alfa-helic es [2]. Indeed, random coil synthetic peptides and random coil conjugated polyelectrolytes may form chiral complexes upon combination, demonstrating the formation of supramolecular chiral aggregation form non-chiral elements. Chirality is one of the tools of this assembly, and we have also shown how chiral CPE's are dominated by their chiral substituents.
This class of polymers can be used for synthesis of DNA nanowires decorated with CPE's, suitable for the formation of conducting wires and electronic devices, from selfassembly in the liquid phase and surface directed assembly on to a substrate. It also delivers tools for materials assembly in new hybrid supramolecular materials. More importantly, it delivers a new type of probe for bioelectronics and biochemistry, in which the conformational flexibility of CPEs is used to read out conformational changes of biomacromolecules as well as biomacromolecular recognition processes. It is therefore an interesting candidate for biochip detectors for DNA and proteins, a novel chromophore for biomolecular tagging and a candidate for luminescent signalling from *in vivo* processes inside the cell.

1 K. P. R. Nilsson and O. Inganas, Chip and solution detection of DNA hybridization using a luminescent zwitterionic polythiophene derivative, *Nature Materials* **2,** 419-U10 (2003).

2 K. P. R. Nilsson, J. Rydberg, L. Baltzer, and O. Inganas, Self-assembly of synthetic peptides control conformation and optical properties of a zwitterionic polythiophene derivative, *Proceedings of the National Academy of Sciences of the United States of America* **100,** 10170-10174 (2003).