MANIPULATION, ASSEMBLY AND CHARACTERIZATION OF OPTICALLY FUNCTIONAL 1-D ORGANIC NANOSTRUCTURES

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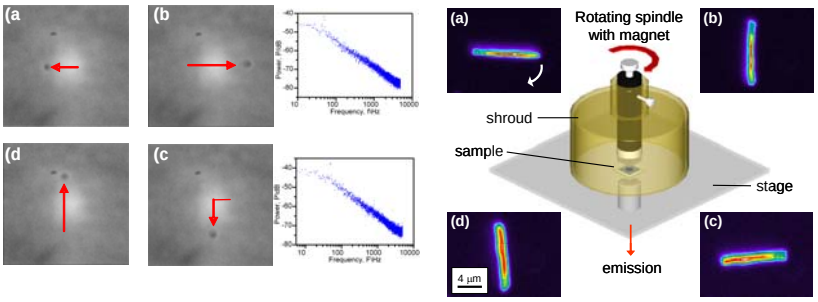
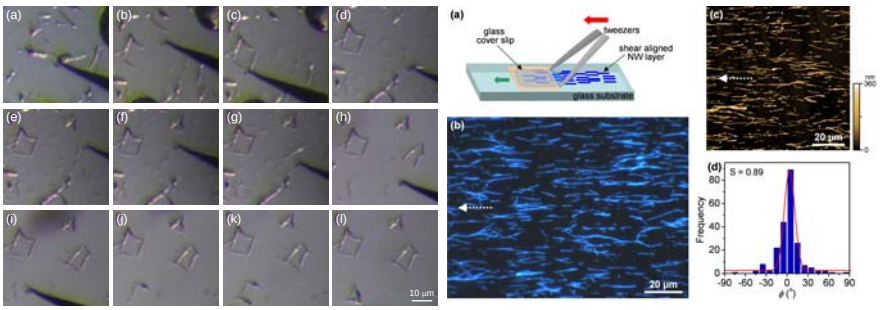
One-dimensional (1-D) nanostructures based on organic materials are attracting significant research interest due to the many novel chemical, physical and electronic properties that may arise in highly anisotropic systems and the possibility for exploitation of such properties in a wide variety of applications. In particular, the potential of semiconducting polymer nanowires and nanotubes is now being explored for realisation of sub-wavelength photonic devices such as photodetectors, lasers and electroluminescent diodes. Successful realisation of such devices relies upon the ability to precisely manipulate and assemble these nanostructures so they can be successfully interconnected and integrated onto chips. While there has been significant research published on the assembly of inorganic nanostructures[1-2] there has been very limited research carried out in relation to the assembly of organic nanostructures.[3-4] To this end, we have explored a range of manipulation and assembly methods. In this talk I will present recent results in our consortium concerning nanowire manipulation and assembly by probe manipulation, magnetic fields, optical trapping, and “shear alignment”.

A probe-based system was successfully developed to manipulate nanowires and assemble them into complex mesostructures for possible device applications as a step towards a nanostructure prototype test platform. AFM analysis was carried out to confirm minimal damage was done to the nanowires. Epi-fluorescence microscopic imaging indicated that the nanowires luminesced under UV excitation with intense blue light emission. Far-field fluorescence microscopy allowed for characterisation of the functionality of whole nanowires while polarized optical microscopic studies of nanowire birefringence indicated axial alignment of the polymer molecules within the wires.

To magnetically manipulate organic nanowires, 30 nm Fe_3O_4 nanocrystals were doped into the wires and were successfully aligned when placed in an external

magnetic field. A demonstration of a doped polymer nanowire as a nanoroter undergoing 360° rotation under the influence of a rotating NbFeB magnet while clocking its polarized flouresence will be presented. We will also introduce a novel optical trapping system using a Laguerre – Gaussian laser beam as a new tool for manipulation, assembly and characterization of organic nanostructures. We will demonstrate for the first time successful trapping of number of organic nanowires and nanotubes and present data concerning the nanostructures physical properties while in the beam. Finally a method to successfully align random nanowire mats has been developed by drop-depositing nanowires from suspension onto a substrate where aligned nanowire mats were achieved by the method of shear alignment.





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