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Carbon nanotubes as efficient nanosieve for controlled assembly of nanoparticles

得獎獎項

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作者姓名

Phua Yi Hui

Abstract

In this work, techniques to explore the capabilities of multi-walled carbon nanotubes (MWNTs) in sorting nanoparticles (NPs) were presented. A droplet of a solution comprising of quantum dots (QDs) with various sizes was deposited on an aligned array of intertwined MWNTs. Photoluminescence (PL) and fluorescence microscopy (FM) revealed that MWNTs were effective nano-sieves that could effectively sort out QDs with a size difference of ~ 2.1 nm. Cadmium Selenide/Zinc Sulfide (CdSe/ZnS)core-shell QDs and Cadmium Sulfide (CdS) QDs were used to explore whether chemical properties of NPs affect the sieving capability of MWNTs. Further investigation on the effects of micro-patterning on the sieving ability of MWNTs was also carried out.PL and FM results suggested that micro-patterning could aid in separation of QDs and thus improve sieving capability of MWNTs. With the above findings, QDs emitting different colors as a result of size difference could efficiently be assembled onto the MWNTs en route to three-dimensional architectures with controlled assembly of NPs. Together with controlled laser power to remove desired amounts of QDs decorated MWNTs, a multi-colored display could be achieved. Further experiments were also carried out to determine the feasibility of introducing MWNTs as filters for NPs. Dilute solutions containing NPs such as gold colloid was run through these MWNTs filters by gravity. Field emission scanning electron microscope (FESEM) images of the samples showed that MWNTs were successful in trapping the nanoparticles. Explorations into the length dependent effect of using MWNTs as filters, suggested that 300μm MWNTs are better nano-sieves compared to 50μm MWNTs.

Keywords: Carbon nanotubes, quantum dots, nano-sieve, nano-filter, micro-patterns, gold colloid