QUANTUM DOT ATTACHMENT AND MORPHOLOGY CONTROL BY CARBON NANOTUBES

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Novel applications in nanotechnology rely on the design of tailored nano-architectures. For this purpose, carbon nanotubes (CNTs) and nanoparticles (NPs) are intensively investigated. Metallic particles can serve as catalysts to create branches on CNTs[1], while semiconducting NPs (or so called quantum dots) can act as light absorbing sites to increase the photoconductivity of CNTs. [2] In previous studies, semiconductor NPs have been grown on CNTs by generation of defects in the CNT lattice by means of covalent functionalisation.[3] This treatment modifies the response of the CNTs in terms of conductivity, optical behaviour, and mechanical stability, a disadvantage for further applications. Other strategies consist in an adsorption of surface active molecules[4,5] or the insertion of some NPs into bundles of CNT.[6]

Here, we present a novel approach in which semiconductor NPs can be specifically attached to non-functionalised and non-pretreated CNTs at a very high degree of coverage, and which, in addition lead to well defined morphological transformations of the NPs. [7]A new property of CNTs has been observed for the first time during the synthesis in which CNTs trigger a morphological transformation of CdSe nanorods into pyramidal-shaped nanoparticles and a tight attachment to the CNTs as shown in figure 1. The morphology of the NPs has been elucidated in 3D by means of high-resolution transmission electron microscopy (HRTEM) and three-dimensional electron tomography (3D-ET).[8] The method is not limited to CdSe but seems to be rather universally applicable to other nanoparticle systems like PbS. The presented non-covalent attachment (according to Raman spectroscopy) should, furthermore, be most advantageous in order to combine the outstanding electrical properties of CNTs with the unique possibility of bandgap tuning of quantum dots. The attachment is observed on both, singlewall and multiwall CNTs and the obtained composite materials exhibit promising photoelectrical response. These nanocomposites may have a strong impact in optoelectronics and photovoltaics.

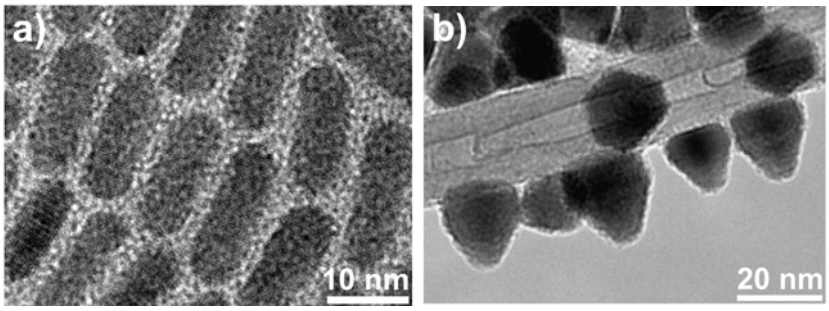

Figure 1. CdSe particles obtained (a) in absence and (b) in the presence of multiwall CNTs.

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