Transferred vertically aligned N-doped carbon nanotube array: use in dye-sensitized solar cells as counter electrodes

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Typically, counter electrodes in DSSCs have been prepared by Pt vacuum deposition or thermal annealing of a Pt precursor on a transparent conductive oxide (TCO) substrate to reduce the overpotential for reduction of I3- to I- in redox electrolytes. Because Pt is one of the most expensive components in DSSCs, the development of finding alternative materials for the development of Pt-free DSSCs is expected to reduce the production cost for DSSCs. CNTs are considered a promising candidate with excellent electrochemical catalytic activities and high electrical conductivities. However, the CNTs used in most approaches were entangled and randomly oriented, which can significantly deteriorate the performance of CNT electrode. In this study, we demonstrate that vertically aligned nitrogen doped CNT counter electrodes can be employed in DSSCs via a 'growth-detachment-transfer' process. The transferred N-doped VA-CNT power conversion efficiency was 7.04%, while that of a reference DSSC with a conventional Pt/TCO counter electrode was 7.34%.