Chirality-specific growth of single-walled carbon nanotubes catalyzed by high melting point tungsten-based alloy nanocrystals

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Structurally uniform and chirality-pure single-wall carbon nanotubes (SWNTs) are highly desired for both fundamental study and many of their technological applications. The ultimate goal of producing just one type of SWNT by controlling its structure during growth has proved to be a considerable challenge over the last two decades [1]. We show that SWNTs of a single chirality, (12,6), can be produced directly with an abundance higher than 92% when using as catalysts tungsten-based bimetallic alloy nanocrystals that have such high melting points that they maintain their crystalline structure during the CVD process [2]. This feature seems crucial because experiment and simulation both suggest that the highly selective growth of (12,6) SWNTs is the result of a good structural match between the carbon atom arrangement around the nanotube circumference and the arrangement of the catalytically active atoms in one of the planes of the nanocrystal catalyst. Initial experiments have shown that other SWNT types, e.g. (16, 0) and (14, 4), can be produced in a chirality-selective manner when using W_6Co_7 nanoparticles prepared under different conditions. We anticipate that using high-melting-point alloy nanocrystals with optimized structures as catalysts paves the way for total chirality control in SWNT growth and will thus promote the development of SWNT applications.

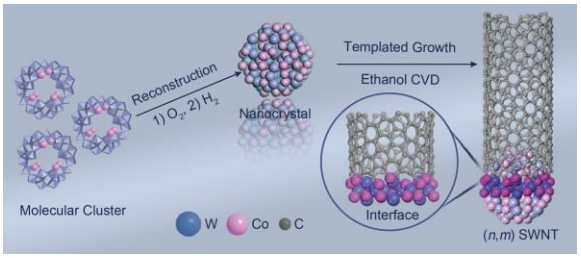

Fig. 1 Preparation of the W-Co nanocrystal catalyst and the templated growth of a SWNT with specified (*n*, *m*).

Reference

[1] Li, Y.; Cui, R.; Ding, L.; Liu, Y.; Zhou, W. et al. *Adv. Mater.* **2010**, **22**: 1508.

[2] Yang, F.; Wang, X.; Zhang, D.; Yang, J., Li, Y. et al. *Nature*, **2014**, doi: 10.1038/nature13434.