SEPARATION OF SINGLE-CHIRALITY SINGLE-WALL CARBON NANOTUBES

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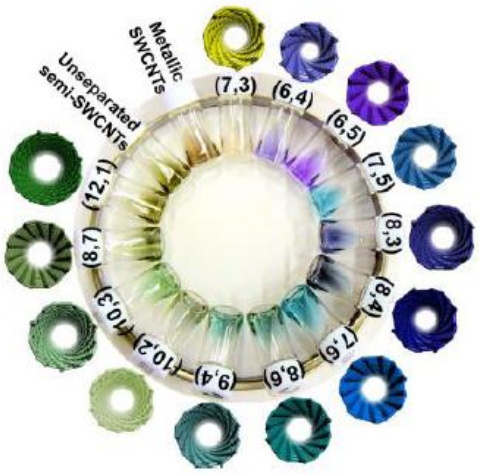
It is well known that no production method can control chirality of single-wall carbon nanotubes (SWCNTs) perfectly. Products are always mixture of variety of structures for both metallic (M-) and semiconducting (S-) SWCNTs. This is one of the most serious problems to bring out their extremely high performance in electronic device applications. A way left to get single chirality SWCNTs is the structure sorting after growth, but was thought to be very difficult. In 2006, however, density gradient ultracentrifugation (DGU) technique made a breakthrough to sorting structure of SWCNTs and opened a new research field, "separation of SWCNTs". [1] It is interesting that DGU has been often used in biology. Because of an analogy in structures between DNA and SWCNTs, it is reasonable that Tanaka tried the gel electrophoresis for the separation of SWCNTs. [2] After these discoveries, DGU and gel separation methods have been competing each other towards more and more precise structure separation. Now we have developed multicolumn gel chromatography method for the precise structure sorting of S-SWCNTs using commercially available Sephacryl gel [3]. Appling this method twice to HiPco SWCNTs, we sorted out 13 kinds of S-SWCNTs by the difference in the local C-C bond curvatures. However, this two-step separation method is too complicated to be applied to the large scale separation. For the further improvements, we have analyzed separation mechanism and then found that it is possible to control the interaction between S-SWCNTs and the Sephacryl gel by changing surfactant concentration and the system temperature. Finally, we succeeded in simplifying the separation procedure and 7 kinds of single chirality S-SWCNTs were sorted out from raw HiPco by a single step multicolumn method. This simple method can be applied to the large scale separation of single chirality SWCNTs. In this presentation, I will show the present and the future perspective of the separation of SWCNTs..



13 kinds of single chirality SWCNTs

[1] M. S. Arnold et al. Nat. Nanotechnol. **1** (2006) 60.
[2] T. Tanaka et al. Appl. Phys. Express **1** (2008) 114001.
[3] H. Liu et al. Nat. Commun. **2** (2011) 309.