Development of New Hydrogels for Structure Sorting of Single-Wall Carbon Nanotubes: Pore Size Effects

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Gel column chromatography method has shown a substantial potential for large scale metal/semiconductor (M/S) separation and further single-chirality separation of single-wall carbon nanotubes (SWCNTs) [1]. In this method, hydrophobic interaction between hydrogel and SWCNT plays crucial role. However, Sephacryl S-200 gel beads that were originally designed for size exclusion chromatography have been used worldwide for the SWCNT separation. Thus, we have been developing new hydrogels optimized for SWCNT separation.

In this study, we have simplified the gel composition to analyze the role of the gel. Based on the previous works, we all know that dextran has a great performance for the separation. Thus simple dextran-based gels were synthesized by crosslinking the dextran using epichlorohydrin. Interestingly, although all gels were simply constructed from dextran, separation performance was nonlinearly depending on the dextran concentration. From systematic experiments, we concluded that the separation performance of the gel was depending on the pore size. A gel that has large pores can adsorb large amount of semiconducting (s-) SWCNTs but a gel with small pores cannot adsorb them inside the gel. Large pores enable the fast access of the SWCNTs into the adsorption sites inside the gel (Fig. 1). However, small pores prevent the access of SWCNTs into the gel, in which case, only the surface of gel bead provide extremely small amount of adsorption sites (Fig. 1). Because the pore size analysis of hydrogel is not easy, very limited information was provided to date. This study will contribute to the design of high performance gels for the low cost industrial-scale SWCNT separation.

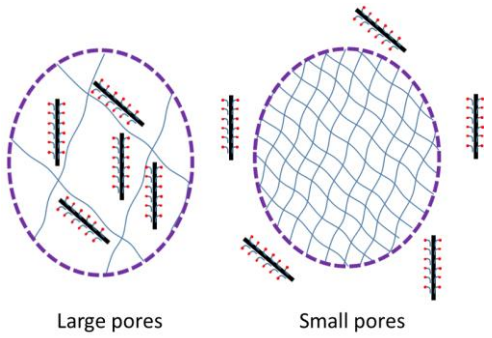

Figure 1. A schematic demonstration of the pore size effect on the SWCNT separation. Large pores enable the fast access of the SWCNTs into the adsorption sites inside the gel. However, small pores prevent the access of SWCNTs into the gel.

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[1] H. Liu et al. Nat. Commun **2**, 309 (2011).