Thermodynamics on Soluble Carbon Nanotubes: How Do Molecules Replace Surfactants on Carbon Nanotubes?

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Investigating the interactions between molecules and single-walled carbon nanotubes (SWNTs) is one of the central issues in carbon nanotube science. Despite enormous efforts focused on efficient chirality sorting, there have only been a few experimental works reported in the literature attempting to quantitatively evaluate the interactions between SWNTs and dispersants[1-5].

We report *thermodynamics on soluble carbon nanotubes* that enables deep understanding the interactions between single-walled carbon nanotubes (SWNTs) and molecules[6]. We selected sodium cholate and single-stranded cytosine oligo-DNAs (dCn (n = 4, 5, 6, 7, 8, 10, 15, and 20)), both of which are typical SWNT solubilizers, and successfully determined thermodynamic properties (D*G,* D*H* and D*S* values) for the exchange reactions of sodium cholate on four different chiralities of SWNTs ((n,m)=6,5), (7,5), (10,2), and (8,6)) for the DNAs. Typical results contain i) the dC5 exhibited an exothermic exchange, whereas the dC6, 8, 10, 12, 15, and 20 materials exhibited endothermic exchanges, and ii) the energetics of the dC4 and dC7 exchanges depended on the associated chiral indices and could be endothermic or exothermic. The presented method is general and is applicable to any molecule that interacts with nanotubes. The study opens a way for *science of carbon nanotube thermodynamics*.

References

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