The investigation effect of ionic liquids on carbon nano tubes dispersion

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Abstract

To deepen the understanding of molecular interaction between Ionic liquids and carbon nanotube, as well as to investigate the influence of the ionic liquids tail length on the adsorption process, we report here the first detailed the adsorption and morphology of aggregates of the ionic liquids containing imidazolium ionic liquids ([$C_n$mim] Cl, n=10,12,14,16) on multi-walled carbon nanotube (MWNT) surfaces. We make a comparison between the various ILs adsorptions onto MWNT to clarify the role of the ionic liquid tail length on the adsorption process. This comparison indicates that by increasing the tail length the larger number of the ionic liquid molecules tend to adsorb onto MWNT which can be attributed to the fact that the [$C_n$mim] Cl with n=16 has a longer chain. In addition, our results show that a longer chain yields the higher packed aggregates in which the IL heads are extended far into the aqueous phase, which in turn may increase the MWNTs stabilization in aqueous suspensions.

Introduction

Ionic liquids (ILs) have drawn increasing interest for their promising role as alternative media in a variety of catalytical, separation, and electrochemical processes as a result of their unique chemical and physical properties .According to the generally accepted definition, these salts are liquid below 100 ◦C, and have a negligible vapor pressure. These properties prompt the interest to replace common volatile organic solvent with ILs [1]. Multi-walled carbon nanotubes (MWNT) show some unique properties, such as high aspect ratios, excellent thermal and electrical conductivities [2]. Carbon nanotubes have high van der waals interaction energy witch cause bounding of CNTS. This high interaction force makes the dispersion stability a challenging task [3]. The chemical structure of ionic liquids mimics that

of amphiphilic cationic surfactants consisting of a non-polar hydrophobic tail and a polar cationic head group. Therefore based on structure activity relationship, a typical long alkyl chain IL could possess surface active properties similar to the conventional cationic surfactants and have tendency to associate in to nano micellar structures [4].

Experimental

1-Decyl-3-methylimidazoliumChloride,1-Dodecyl-3-methylimidazoliumChloride,1-Tetradecyl-3-methylimidazolium Chloride, 1-Hexadecyl-3-methylimidazolium Chloride were synthesized by Dr. Sharifi in Chemistry and Chemical Engineering Research Center of Iran [5]. All samples were equilibrated at 25 °C in a thermostated bath. Samples were prepared by mixing 0.01wt% MWNT and ionic liquid with distilled water. Then samples were ultrasonicated for two hours by ultrasonic bath. All samples were equilibrated at 25°C in a thermostatic bath. [5] Absorption spectra of IL at 25°C were recorded with a UV-vis 1240 spectrophometer Shimadzu using a quartz cell of path length 1 cm.

Results and Discussion

The evaluation of the degree of dispersion of CNTs in aqueous media can be achieved by recording the UV–vis spectra of the dispersions. Since individualized CNTs are active in the UV-Vis region and exhibit characteristic bands corresponding to additional absorption due to 1D Van Hove singularities. However, bundled CNTs are hardly active in the wavelength region between 200 and 1200 nm. Therefore, it is pertinent to compare the amount of individually dispersed CNTs in the solution through the absorption intensity. The UV–vis spectra of aqueous CNT dispersions using different ionic liquids are measured. Figure 1 shows the evolution of absorbance for different ILs. As can be seen in Figure 1, the increase of ILs chain length lead to the increase of the absorbance intensity. Hence, according to our results, the dispersing power of ILs increases with increasing IL chain length.

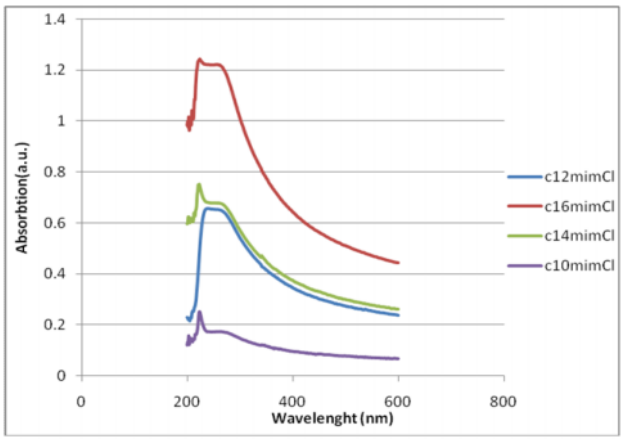

Figure 1. UV-vis-NIR spectra of aqueous MWNT dispersion using different Ionic liquids at their corresponding optimum concentrations

Conclusions

The ionic liquid can disperse MWNTs effectively even at low concentration. The zeta-potential and surface tension measurement prove that $C_n$mimCl molecules adsorbed on the MWNT surface by the π-π stacking interaction and hydrophobic interaction. The results show that intensity of absorption increase to increasing IL chain length. Because, hydrophobic property of ionic liquids increases with increasing IL chain length. Hence, according to our results, the dispersing power of ILs increases with increasing IL chain length.

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