ANALYTICAL POTENTIAL OF THE CARBON NANOPARTICLES-IONIC LIQUID COMBINATION

M.L. Polo-Luque, B. M. Simonet, M. Valcárcel
Department of Analytical Chemistry, University of Córdoba, E-14071 Córdoba, Spain
Tel./Fax +34 957 218616; E-mail: qa1meobj@uco.es

Carbon nanotubes have exceptional properties which make them excellent candidates for numerous applications in nanotechnology and material sciences. However, purification and characterization of CNTs bundles presents still an analytical challenge. In this communication, the potential of ionic liquids as a medium with a capacity to debundling CNTs is discussed fundamentally for SWNTs, which exist in heavily entangled aggregates of ropes or bundles.

The dispersions and the possible interactions between bmimBF_4 and the SWNTs were studied by Raman spectroscopy. The spectra of dispersions containing different SWNT concentrations were recorded. The presence of ionic liquid bands also hindered the study of the RBM mode. In order to avoid interference from the ionic liquid, we focused our study in the G and G' bands. Although no significant changes in the G-band position were observed a decrease in the band width was noticed. In fact, this seems to be due to a loss of the high frequency side of the band. This effect could be attributed to a decrease of the intertube interactions in the dispersions. Furthermore, in the dispersions the G'-band is clearly blue-shifted.

The fact that especially at lower SWNTs concentration, the ionic liquid strongly affects the Raman spectra of SWNTs can be attributed to specific interactions between the imidazolium ion component and the π-complex of the SWNT. Such interaction give rise to the presence of a new system, SWNT coated with IL, consisted in isolated or weakly interacting SWNTs. The extend of the π-complex depends on the degree of overlap between p_z orbitals in the carbon atoms or in others words on the cylindrical shape of the SWNTs.

From the Raman results, debundled of the SWNTs at lower concentration and milder sonication treatment can be assured. Therefore, these dispersions were appropriate for further analyses of SWNTs by CZE. After encapsulation of the nanotubes in sodium dodecyl sulfate micelles, separation of the solubilized SWNT was accomplished using as background electrolyte a 50 mM formic acid solution at pH 2.0 and working at -10 kV. Separation was achieved in only 4 min being possible to distinguish more than 8 peaks of SWNTs from the analysis of commercial SWNT bundles.

On the other hand, It is well known that ionic liquids containing CNTs above 0.5-1 wt % concentration form a gel that can be used to create new soft materials. Therefore, the analytical material of these materials will be also discussed in this communication. These materials present a high capacity to adsorb but also to absorb analytes. The most important aspect is the synergic effect that exists between the carbon nanotubes and the ionic liquid which result in a high capacity to preconcentrate analytes.