NEW AMINE FUNCTIONAL IONIC LIQUID AS BUILIDING BLOCK IN NANOTECHNOLOGY

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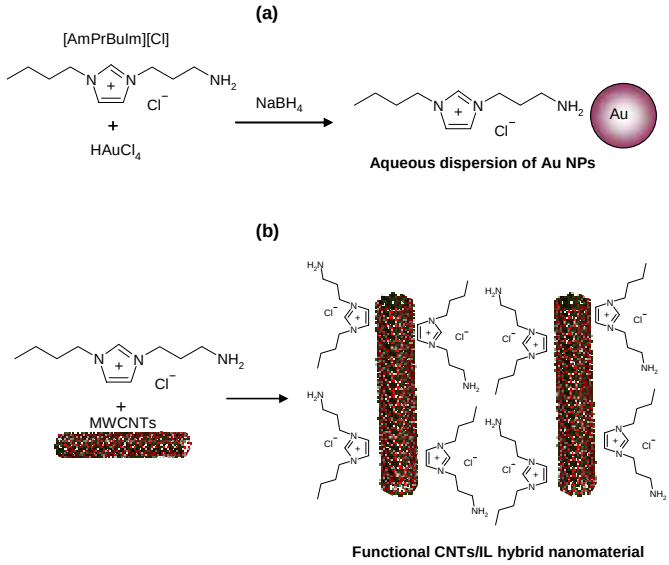
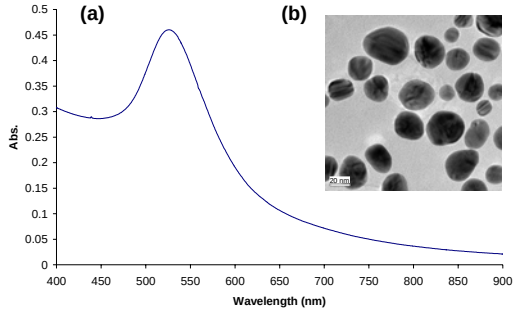
In the last few years, ionic liquids (ILs) have been the focus of numerous investigations in diverse fields like organic and analytical chemistry, biochemistry, electrochemistry, catalysis, and more recently in nanotechnology. Interestingly, the use of ILs in nanotechnology is having an exponential increase in the last years .[1] Most of the activities are related to the potential offered by the combination of ILs with different kinds of nanoobjects such as metal nanoparticles (NPs) and carbon nanotubes (CNTs). For instance, ILs have been used as solvents in organic chemical reactions catalyzed by metallic NPs as well as in the development of synthetic procedures with a good control of the NPs size. On the other hand, ILs and CNTs show also a great affinity and interesting possibilities. As an example, pioneering works by Aida et al. reported the synthesis of CNTs/IL hybrids, that they named "bucky gels", by mixing IL and CNTs[2]. This CNT/IL combination resulted in much finer bundles in the heavily entangled nanotubes. Recently, ILs have also been used to functionalize the surface of the CNTs and to develop new phase transfer methods[3-5].

In this communication we will show our recent results in the use of Ionic Liquids and Polymeric Ionic Liquids in the development of nanomaterials. As an example we report here the synthesis of a new amine-functional ionic liquid (AFIL) 1-(3-aminopropyl)-3-butylimidazolium chloride [AmPrBuIm][Cl] and its application as "building block" in nanotechnology. The AFIL molecule could be used both as stabilizer in the synthesis of gold NPs and in the development of functional CNTs/IL hybrid nanomaterials by mixing with MWCNTs (Scheme 1).



Scheme 1. (a) Synthesis of Au NPs with AFIL. (b) Modification of MWCNTs with AFIL resulting in functional CNTs/IL hybrid nanomaterials

Thus, Figure 2a shows the UV-vis spectrum of the aqueous dispersion which exhibited a surface plasmon resonance band at 525.5 nm. Moreover, the size, shape and dispersity of the Au NPs were determined with transmission electron microscopy (TEM). TEM image of Au NPs stabilized by AFIL is shown in Fig. 1 (b) which illustrates the formation of spherical particles with average diameters of 33 nm. On the other hand, Figre 2b shows AFM (atomic force microscope) phase images of unmodified MWCNTs and the obtained functional CNTs/IL hybrid nanomaterials. Unmodified MWCNTs are heavily entangled in bundles with diameter of ~ 80 nm. Interestingly, functional CNTs/IL hybrid nanomaterials resulted in isolated MWCNTs forming much finer bundles with a diameter of ~ 30 nm. MWCNTs, that normally exist as 3-D networks of heavily entangled bundles, were untangled to much finer bundles or individual nanotubes due to the cation-π interactions between the IL and the surface of the CNT.



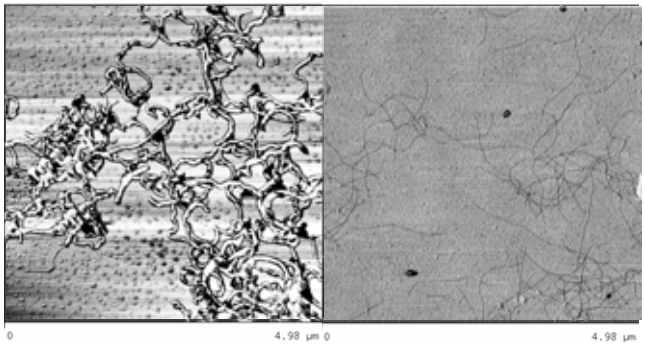


Figure 2a (left). (a) UV-vis absorption spectrum of Au NPs in aqueous dispersion stabilized with an AFIL. (b) TEM image of the AFIL stabilized Au NPs.Fig. **Figure 2b (right)** AFM phase images of (a) unmodified MWCNTs and (b) functional MWCNTs/AFIL hybrid nanomaterials.

These new functional Ionic Liquid leads to more complex nanomaterials, bearing an amine group, which offers the possibility to interact with biological compounds opening new opportunities. Bioactive functional hybrid nanomaterials, biosensors and conductive nanocomposites are envisaged as new applications.

References

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