

CHARACTERIZATION OF POLYANILINE/BENTONITE NANOCOMPOSITES

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Intercalation-polymerization is a promising strategy to study the confining polymer chains in the nanometer size inorganic galleries. As conjugated polymers usually have high electric conductivity with many potential applications, the insertion of conjugated polymers in the layered inorganic materials has received extensive attention over the past few years. Chemical synthesis of Bentonite/polyaniline nanocomposites has been extensively reported previously. We found that when the anilinium ion concentration is low (0.1 mol dm^{-3}), anilinium ions do not exchange for the interlayer cations present in the ordinary Bentonite. However, we have recently discovered that, if the interlayer cations are exchanged for ammonium ions, then the latter can be exchanged for anilinium ions. We can, therefore, prepare Bentonite/polyaniline nanocomposites even by employing low concentrations of anilinium ions. This has the advantage that the interlayer spaces of Bentonite can be successively filled with the conducting polymer in order to possess multilayers of polyaniline within the intergalleries. The X-ray diffraction (XRD) studies of Bentonite/polyaniline thus prepared were performed after heat-treatment at different temperatures ($25 \text{ }^\circ\text{C}$, $100 \text{ }^\circ\text{C}$ and $150 \text{ }^\circ\text{C}$), and they revealed the presence of polyaniline within the intergalleries. The repeated insertion of the polymer results in gradual increases in d spacing (Once loaded $d = 12.4 \text{ \AA}$, twice loaded $d = 13.4 \text{ \AA}$ at and thrice loaded $d = 14.1 \text{ \AA}$, measured after heat treatment at $150 \text{ }^\circ\text{C}$ for 1 hour).

The process of the polymer loading was also monitored by Fourier Transform Infrared (FTIR) spectroscopy. The hydroxyl region of the IR spectrum of Bentonite has two distinct features due to $\bar{\nu}_{\text{O-H}}$ at 3620 cm^{-1} and $\bar{\nu}_{\text{O-H}}$ at 3500 cm^{-1} for isolated and hydrogen bonded O-H groups, respectively, of the octahedral layer. The second band is significantly broadened when the polymer layer is present in the once loaded composite. The broadening is still present when the polymer is loaded twice. This suggests the increase in extent of H-bonding due to interaction between the interlayer and the polymer. However, in the third loading, the IR spectrum shows a distinct feature indicating the filling of surface sites.

These results can be interpreted by considering the intercalation of the polymer within the intergalleries of the clay particles in the first and the second times. When the polymer is saturated with polyaniline, any extra polyaniline will then have to reside on the surface of the clay as shown in FTIR of the thrice-loaded Bentonite. These results are in good agreement with the XRD data given above. The conductivities measured using the four-point method show that the material has exclusively electronic conductivity, which enhances due to the repetitive incorporation of the polymer.

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