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Morphological, Dielectric and Electrical Conductivity Characteristics of Clay-Containing Nanohybrids of Poly(N-Vinyl Carbazole) and Polypyrrole

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ABSTRACT

Poly(N-vinyl carbazole) (PNVC) and polypyrrole (PPY)-montmorillonite (MMT) clay hybrids were prepared by mechanical grinding of the respective monomers with MMT followed by subsequent standard processing methods. Fourier transform infrared spectroscopic studies confirmed the inclusion of the polymers in the composites. The morphologies of the hybrids were investigated by trans-mission electron microscopic techniques, which suggested the formation of intercalated structures. X-ray diffraction analyses indicated the enhancement of 'd001' values in MMT implying intercalation of the polymers into the nano-interlamellar spaces of MMT. The dielectric constants of PNVC-MMT hybrids were improved (60–180) relative to the homopolymer (3–6) in the frequency range 0.1-25 kHz. PPY-MMT hybrid also showed significantly higher values of dielectric constant (2000–4000) relative to the corresponding base polymers. These variations were dependent on the MMT/polymer feed ratio in the frequency range (1-25 kHz). This feature could manifest from the characteristic differences in the interfaces between the grains and grain boundaries of the composites, which control the dielectric properties of the system. Relaxation behavior for the composites was explained by considering the Maxwell-Wagner two-layered dielectric models. The ac conductivity was found to be dependent on frequency in the entire frequency range of study (100 Hz to 25 kHz), which indicated that the composites had few free charges for conduction, and frequency dependent conductivity was due to trapped charges in the grain boundary.