

C
540
WJT

**THERMAL DEGRADATION BEHAVIOR OF CLAY POLYMER
NANOCOMPOSITES**

A PROJECT REPORT PRESENTED BY

KOSALA TILAN WIJERATNE

to the Board of Study in Chemical Sciences of the
POSTGRADUATE INSTITUTE OF SCIENCE

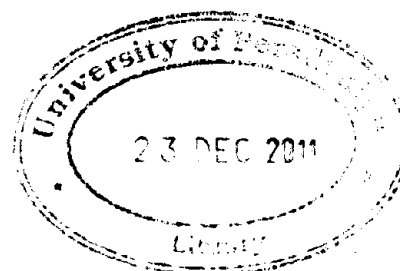
*in partial fulfilment of the requirements
for the award of the degree of*

MASTER OF SCIENCE IN NANOSCIENCE AND NANOTECHNOLOGY

of the

**UNIVERSITY OF PERADENIYA
SRI LANKA
2011**

652155



ABSTRACT**THERMAL DEGRADATION BEHAVIOR OF CLAY POLYMER
NANOCOMPOSITES****W.M.K.T.Wijeratne**

Postgraduate Institute of Science

University of Peradeniya

Peradeniya

Sri Lanka

Montmorillonite - polyaniline (MMT-PANI) nanocomposites containing different amounts of PANI were prepared by the intercalation of aniline monomer into pristine MMT together with cation intercalated MMT [Ce(IV)-MMT, Fe(III)-MMT and Cu(II)-MMT] followed by the subsequent oxidative polymerization of the aniline in the interlayer spacing (*d*-spacing) to give MMT-PANI nanocomposites. Similarly, montmorillonite - polypyrrole (MMT-PPY) nanocomposites containing different amounts of PPY were prepared by the intercalation of pyrrole monomer into pristine MMT together with cation intercalated MMT [Ce(IV)-MMT, Fe(III)-MMT and Cu(II)-MMT] followed by the subsequent oxidative polymerization of the pyrrole in the interlayer spacing (*d*-spacing) to give MMT-PPY nanocomposites. The nanocomposites thus prepared were characterized by X-Ray diffraction (XRD), Scanning electron microscopy (SEM), Fourier-transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC). The XRD results and FTIR results confirmed that PANI has been intercalated within the MMT interlayer. Thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) showed improved thermal stability for the intercalated nanocomposites in comparison with the pure PANI and PANI clay nanocomposites. The thermal degradation behavior of MMT-PANI nanocomposites and MMT-PPY nanocomposites prepared by in-situ intercalative polymerization of aniline and pyrrole

respectively has been analyzed in a wide range of temperatures (30 °C to 1000 °C) by the thermogravimetric analysis (TGA) and by differential scanning calorimetry (DSC). In air, the thermal degradation of polyaniline (chemically polymerized) starts at 255 °C, whereas that in Na⁺-MMT-polyaniline and in Cation intercalated MMT-polyaniline nanocomposites start at around 280 °C. Thermal degradation of the PANI/Ce(III)-MMT 1 [Aniline(g)/MMT(g) = 1.1/1.0] nanocomposite starts at 330 °C and it is the thermally most stable MMT-PANI nanocomposites. Thermal degradation of polypyrrole (chemically polymerized) starts at 183 °C, whereas that in Na⁺-MMT-polypyrrole and in Cation intercalated MMT-polypyrrole nanocomposites start at around 200 °C. Thermal degradation of PPY/Ce(III)-MMT 1 [Pyrrole(g)/MMT(g) = 1.1/1.0] nanocomposite starts at 221 °C and it is the most thermally stable among all the MMT-PPY nanocomposite. Thermal gravimetric analysis results suggests that the Ce(IV) intercalated nanocomposite is thermally most stable nanocomposite for the MMT-PANI nanocomposites as well as MMT-PPY polymer nanocomposites. This improvement in the thermal stability for the nanocomposites is due to the presence of MMT nanolayers with a high aspect ratio acting as thermal barriers. However, better stability of Polyaniline in Ce(IV)-intercalated MMT may be due the formation of ordered well-aligned polymer within the inter-galleries of MMT with a high aspect ratio. Oxidation potential of the Ce(IV) ion is responsible to achieve such well ordered patterns of polymer chains within the MMT layers. Since Ce(IV) ion has the highest oxidation potential among the other intercalated cations. Thus shielding the degradation of PANI and PPY in the Ce(IV) ions intercalated MMT nanogalleries and Ce(IV) ions intercalated MMT nanocomposites thermally more stable when compared with other cation intercalated MMT nanocomposites.

Keywords: Polyaniline; Polypyrrole; Na⁺-montmorillonite; Intercalation; Nanocomposites; Thermal stability; Thermogravimetric analysis (TGA); Differential scanning calorimetry (DSC).