P-3-06

Preparation and Properties of Colorless Polyimide/Clay Nanocomposite Films for Flexible Substrate

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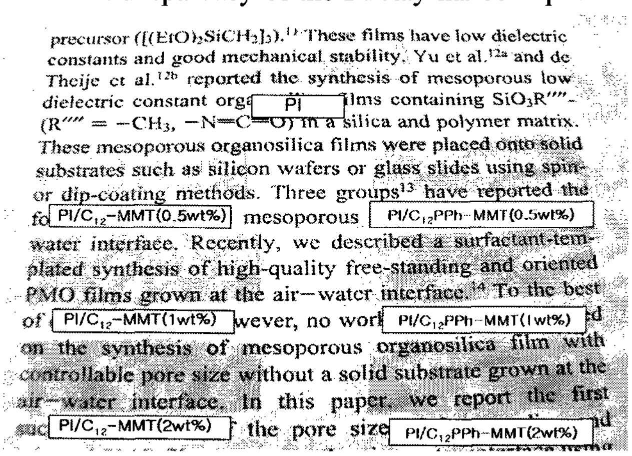
Polyimide/clay nanocomposites for flexible colorless substrates were prepared from the solution of poly (amide acid) and organically modified–montmorillonites(OMMTs) using N,N-dimethylacetamide as a solvent. Poly(amide acid) was prepared from the reaction of 2,2'-bis-(3,4-dicarboxyphenyl)Hexafluoro-propane dianhydride(6FDA) and 2,2'-bis(trifluoromethyl)-4,4'-diaminophenyl(TFDB). Polyimide(PI) is used largely for microelectronics. However it would be desirable to reduce the coefficient of thermal expansion (CTE), amount of moisture absorption and gas permeability, because those properties of PI are not sufficient for advanced electronics use. Montmorillonite(MMT) consists of stacked silicate sheet about 2000Å in length, 10Å in thickness. It has a low CTE and a high gas and water barrier property (MMT is dispersed homogeneously into PI matrix and oriented parallel to the film surface). Owing to this special structure of clay, the defects of PI are improved. As clay contents increase, PI/clay nanocomposites show better properties than pristine PI. However the transparency of the PI/clay nanocomposite films are reduced a little.



Transparency of PI and PI/OMMT nanocomposite films with various OMMT contents.

Substrate	Avg. Transmission(%) (400nm – 700nm)	Sheet Resistance (Ω/sq.)	Figure of merit FTC(x 10-3Ω-1)	Figure of merit ΦTC(x 10-3Ω-1)
Fluorinated PI	79	119.36	6.61	0.79
PI/C_{12}-MMT 0.5wt%	77	96	8.02	0.76
PI/C_{12}-MMT 1wt%	76	77.18	9.85	0.83
PI/C_{12}-MMT 2wt%	75.4	40.09	18.81	1.48
PI/C_{12}PPh-MMT 0.5wt%	76	76.86	9.89	0.84
PI/C_{12}PPh-MMT 1wt%	75.7	44.46	17.0	1.39
PI/C_{12}PPh-MMT 2wt%	73.5	38.55	19.1	1.19
Glass	85.9	24.47	35.1	8.93
Commercial ITO	83	9.28	89.4	16.7
ITO PI*	76.9	19.8	38.8	3.65

* H. Lim et. al, Adv. Mater., 18,14(2002)

The sheet resistance, figure of merit and average transmittance of the ZnO:Al films deposited on Corning 1737 glass and PI substrates at *T*s= 200 ℃