Low-level Thermal Expansion Behavior of Random and Block Copolyimide/Silica Nanocomposite Thin Films

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A series of random and block copolyimide/silica nanocomposites has been prepared from an aromatic polyamic acid derived from 4,4'-oxydianiline (ODA), 1,4-phenylene diamine (PDA) and 1,2,4,5-benzentetracarboxylic dianhydride (PMDA) and a silica network. In this study, Tetraethyl Orthosilicate (TEOS) was used for generating inorganic polymer with the structure of Si-O-Si bond. Random and block copolyimide/silica nanocomposites were synthesized with the different silica contents (0, 6, 12, 18 wt%) and their cured films were all transparent. For the analysis, they were analyzed by FTIR spectroscopy, Thermogravimetric analyzer (TGA), Prism coupler, Dielectric constant analyzer, Thermomechanical analyzer (TMA), Nanoindentation and X-ray diffractometer (XRD). Both dielectric constant and coefficient of thermal expansion (CTE) were decreased with increasing silica contents. The reduction in the CTE and the dielectric constant of the co-PI/silica nanocomposites can be explained in terms of the free volume increase by the presence of the silica network resulting in a loose co-PI structure.