

## Polyimide Nanocomposite Thin Films Containing Epoxy Functionalized Octavinylpentacyclo(octasiloxane) with Low-level Dielectric Constant for Electronic Devices

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A novel polyimide nanocomposites containing Epoxy functionalized octavinylpentacyclo (octasiloxane) has been prepared by polymerization of 4,4'-oxydianiline (ODA), 1,2,4,5-benzotetracarboxylic dianhydride (PMDA), Epoxy-POSS. Epoxy-POSS was synthesized from octavinylpentacyclo(octasiloxane) and glycidyl methacrylate under the ultraviolet (UV) condition. And then we incorporated Epoxy-POSS into the polyimide matrix to lower dielectric constant (low-k) and thermal expansion. We prepared Epoxy-POSS polyimide nanocomposites as varying the Epoxy-POSS contents. When contents of the Epoxy-POSS in the nanocomposites are 0, 3, 6, 9 wt%, we denote them PI, PI3P, PI6P, PI9P, respectively. The lowest dielectric constant achieved of the PI-POSS material (PI9P) is 2.20 by incorporating 9wt% Epoxy-POSS (pure PI,  $k=3.18$ ). And the coefficients of thermal expansion (CTE) of the PI, PI3P, PI6P and PI9P are 23.16, 21.77, 18.29 and 15.85 ppm/°C, respectively. The reduction in the dielectric constant and the CTE of the PI-POSS nanocomposites can be explained in terms of the free volume increase by the presence of the POSS-tethers network resulting in a loose PI structure.