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Preparation and Characterization of Novel Siloxane-Modified Hyperbranched Polyimides

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Polyimides have been widely used for microelectronic applications as interlayer dielectrics because of their excellent thermal stability, high mechanical properties, chemical and solvent resistance, and low dielectric constant. In electronics packaging, low dielectric materials minimize crosstalk and maximize signal propagation speed in devices. Therefore, the development of *low-k* polyimides has been desired. In this study, preparation and properties of novel siloxane-modified hyperbranched polyimide (SMHBPI) were investigated. Hyperbranched polyamic acid as a precursor was prepared by polycondensation of a triamine, 1,3,5-tris (4-aminophenoxy) benzene (TAPOB), and a dianhydride, 4,4'-(hexafluoroiso-propylidene) diphthalic anhydride (6FDA) or 4,4'-oxydiphthalic anhydride (ODPA), and aminopropyl-terminated polydimethylsiloxane. The imidization of polyamic acid thin films was performed in steps for 1h at 100°C, 1h at 200°C, and 2h at 250°C. 5% weight-loss and glass transition temperatures of SMHBPI slightly decreased with increasing siloxane content. Thermal decomposition temperature of SMHBPI was lower than that of the non-modified polyimide because the dissociation of Si-C was easily occurred. Tensile strength of SMHBPI was kept constant or slightly increased up to about 10wt% of siloxane content, and the Young's modulus was linearly decreased with increasing siloxane content due to increased elasticity. Coefficient of thermal expansion of SMHBPI was increased with increasing siloxane contents because of increased flexibility and fractional free volume (FFV) of the polymer by the incorporation of siloxane unit, and Dielectric constant of SMHBPI was decreased with increasing siloxane and fluorine contents because of increased FFV, decreased electronic polarizability, and increased hydrophobicity.

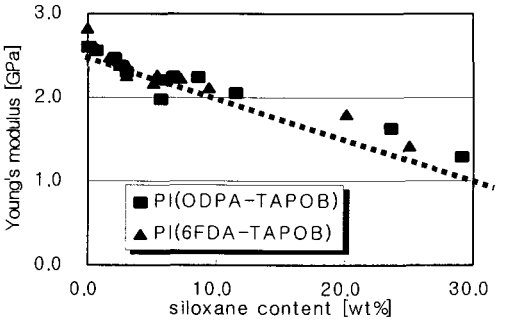

Figure 1. Young's modulus of siloxane-modified hyperbranched PI (O DPA-TAPOB) and PI (6FDA-TAPOB) plotted against siloxane content.

References

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