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Synthesis and Characterization of Novel Polyimides from Trifluoromethylphenyl Substituted Pyromellitic Dianhydrides

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Substituted dianhydride monomers, such as 3,6-di(3′,5′-bis(trifluoromethyl)phenyl) pyromellitic dianhydride (12FPMDA), 1-(3′,5′-bis(trifluoromethyl)phenyl) pyromellitic dianhydride (6FPPMDA), and 1-(4′-trifluoromethylphenyl)pyromellitic dianhydride (3FPPMDA) were synthesized in our lab, while 3,6-di(4′-trifluoromethylphenyl)pyromellitic dianhydride (6FPMDA), 3,6-diphenyl pyromellitic dianhydride (DPPMDA), and 1-phenyl pyromellitic dianhydride (PPMDA) were also prepared for comparison. All monomers were characterized by FT-IR, ^{1}H-NMR, ^{19}F-NMR, elemental analyzer (EA) and melting point apparatus, and utilized to prepare polyimides with aromatic diamines such as bis(3-aminophenyl) 3,4-bis(trifluoromethyl)phenyl phosphine oxide (*m*DA6FPPO), bis(3-aminophenyl) 4-(trifluoromethyl)phenyl phosphine oxide (*m*DA3FPPO), and bis(3-aminophenyl) phenyl phosphine oxide (*m*DAPPO). Polyimides were synthesized via a two-step process; preparation of poly(amic-acid) in *p*-chlorophenol with isoquinoline, followed by solution imidization at the reflux temperature for 12 hrs, and was designed to molecular weights of 20,000 g/mol via off-stoichiometry. The resulting polyimides were characterized by FT-IR, NMR, GPC, DSC and TGA, and their solubility, solution viscosity, water absorption, CTE and dielectric constant were also evaluated. The polyimides exhibited excellent solubility even in acetone and toluene, high T_g (>311°C), good thermal stability (>518°C in air), and well controlled molecular weight (19,000-21,000 g/mole). They also provided low CTE (35-50 ppm/°C), water absorption (1.26-1.35wt%) and dielectric constant (2.49-2.52).

Keywords: polyimides, fluorinated, refractive index;

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