CHAPTER V
CONCLUSIONS

The polyimide-clay nanocomposite thin films were prepared by simultaneously imidization of poly(amic acid) precursors with a dodecylamine-montmorillonite. The TEM results indicated that the alumino-silicate layers produced fine dispersion in the polyimide matrices, but the dispersion became poorer for high clay content. The WAXS patterns of the clay nanocomposite film revealed that the interlayer spacing of an organophilic-clay expanded when the clay was dispersed in the polymer matrices, but some of them existed in the original form. These results suggested that the polyimide-clay hybrid can be classified as partial-exfoliated nanocomposite. The TGA results also showed a thermal stability improvement by as much as 30 °C relative to untreated polymer.

The organophilic-clay reduced the in-plane CTE, T_e, and T_y of both rigid-rod (BPDA/PDA) and flexible (BTDA/ODA-MDA) polyimides, but all of treated polyimides have higher in-plane CTE as compared to the silicon substrate. Ten cycles of thermal cycling operation showed no significant effect on the in-plane CTE of both BPDA/PDA polyimide films and its clay nanocomposites. The tensile modulus and strength at break of the clay nanocomposite films were improved relative to pure polymer, but percent elongation at break of the material showed a reduction with increasing clay content. This result indicated that adding of organophilic-clay into polyimide induces some brittle characteristics. Water absorption of nanocomposite films is reduced as compared to pure polyimide. Dielectric strength of the nanocomposite is also improved with increasing clay content, but the opposite trend occurred when clay content exceeds 3 %wt for the rigid rod-like polyimide.