Residual Stress Behavior of Mechanically Stable Polyimide Thin Films based on *p*-phenylene and *p*-oxydianiline on Si Wafer Substrate

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Four different strucuture polyimide thin films based on *p*-phenylene diamine and *p*-oxydianiline were synthesized by using two different dianhydrides, PMDA and BPDA, and their residual stress behavior and mechanical properties was investigated by using Thin Film Stress Analyzer (TFSA) and nano-indentation method. The residual stress behaviors and mechanical properties were correlated to the morphological structure in polyimide films. The morphological structure of polyimide thin films was characterized by x-ray diffraction patterns and refractive indices. The PDA-based polyimide films, PMDA-PDA and BPDA-PDA, showed relatively lower residual stress higher hardness than the corresponding ODA-based polyimide films, PMDA-ODA and BPDA-ODA. The morphological structure (i.e., film orientation, packing order, crystallinity) of polyimide films is strongly dependent upon the chemical backbone structure, which may impart the residual stress behaviors and hardness/modulus in polyimide thin films. The in-plane orientation and molecular ordered phase was enhanced with increasing order BPDA-ODA < PMDA-ODA < BPDA-PDA < PMDA-PDA.