Novel High Temperature Resistant Polypyrrolones with Asymmetric Biphenyl Moiety in the Main Chain: Synthesis and Characterization

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Summary

Polypyrrolone (PPy) is one of the most known high temperature heteroaromatic polymers. In practice, they have found wide applications as gas permeable membranes, electron-transporting materials or conductive polymers. The rigid molecular backbones impart good thermal stability to PPys, however, inevitably sacrifice their processability at the same time. In this paper, asymmetry strategy had been utilized and asymmetric biphenyl moiety was introduced into the molecular chains of PPys. Two novel polypyrrolones (PPys) had been synthesized from 2,3,3',4'-biphenyl tetracarboxylic dianhydride (a-BPDA) and two aromatic tetraamines, 3,3',4,4'-tetraamino biphenyl (TABP) and 3,3',4,4'-tetraamino diphenylether (TADPE), respectively via soluble poly(amide amino acid) (PAAA) precursors, followed by thermal cyclization at elevated temperatures. The polymerization and curing conditions were studied and confirmed. Asymmetric biphenyl structures endowed the polymers with good combined properties. For example, flexible and tough PPy films with acceptable mechanical properties were obtained. Tensile strengths of higher than 70MPa and elongations at break of higher than 6% were achieved. The PPy films with final curing temperature of 350^{0}C exhibited good thermal stability and the 10% weight loss temperatures were 610.3^{0}C for PPy-I, and 607.8^{0}C for PPy-II. The residual weight ratios at 700^{0}C were higher than 80%. In addition, the PPy films showed good dielectric properties with dielectric breakdown strengths of higher than 100V/μm and dielectric constants of 3.64 for PPy-I and 3.53 for PPy-II.