SYNTHESIS AND STRUCTURE-PROPERTY RELATIONSHIPS OF 3-METHYLENE-2-PYRROLIDONE-BASED (CO)POLYMERS

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ABSTRACT

This study describes the synthesis, polymerization and characterization of 3-methylene-2-pyrrolidone-based (3M2P) monomers. 3M2P is the lactam analogue of tulipalin A.

3M2P was synthesized by condensing the corresponding phosphorous ylide with paraformaldehyde. Conventional radical homopolymerizations of 3M2P were successful and polymers were characterized by NMR spectroscopy and size exclusion chromatography (SEC). It was discovered that the polymer, P(3M2P), has excellent thermal stability with a T_g of 285 °C and a decomposition temperature between 400-500 °C. P(3M2P) proved to be extremely water-soluble, but it did not dissolve in most organic solvents. The thermal stability, and solubility behavior was ascribed to the structurally rigid lactam moiety and its strong hydrogen-bonding ability. Cytotoxicity testing revealed that P(3M2P) was completely non-toxic.

Finally, the polymerization versatility of 3M2P was evaluated via different reversible-deactivation radical polymerization (RDRP) techniques in an attempt to create well-defined macromolecules with precision. The RDRP techniques include single electron transfer living radical polymerization (SET-LRP), reversible deactivation fragmentation (chain) transfer (RAFT) polymerization, and nitroxide mediated polymerization (NMP). SET-LRP and RAFT polymerizations proved to be controlled, with a $Đ < 1.4$, whilst NMP exhibited poor control.

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