Step-Growth Polymerization Towards the Design of Polymers: Assembly and Disassembly of Macromolecules

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Abstract

Step-growth polymerization provided an effective method for the preparation of several high performance polymers. Step-growth polymerization was used for syntheses of poly(siloxane imides), polyesters, poly(triazole esters), poly(triazole ether esters), and epoxy networks. Each of these polymeric systems exhibited novel structures, and either photoreactive capabilities, or high performance properties.

There is an increasing trend towards the development of photoactive adhesives. In particular these polymers are often used in flip bonding, lithography, stimuli responsive polymers, drug delivery, and reversible adhesives. The ability to tailor polymer properties carefully with exposure to light allows for very unique stimuli responsive properties for many applications. This dissertation primarily investigates photoreactive polymers for reversible adhesion for use in the fabrication of microelectronic devices. In particular cyclobutane diimide functionality within polyimides and poly(siloxane imides) and o-nitro benzyl ester functionality within polyesters acted effectively as chromophores to this end.

Thermal solution imidization allowed for the effective synthesis of polyimides and poly(siloxane imides). 1,2,3,4-Cyclobutane tetracarboxylic dianhydride acted as the chromophore within the polymer backbone. The polyimides obtained exhibited dispersibility only in dipolar, aprotic, high boiling solvents such as DMAc or NMP. The obtained poly(siloxane imides) demonstrated enhanced dispersibility in lower boiling organic solvents such as THF and CHCl₃. Dynamic mechanical analysis and tensile testing effectively measure
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