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Thermally Resistant Polymers and their Use

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The progress and advancement in research on synthesis and evaluation of properties of new polymeric materials containing carbazole ring has been observed in last few years. Carbazole and its derivatives are used in chemistry and technology of drugs, pharmaceuticals, polymers, dyes, pesticides, surfactants, stabilizers and other additives for plastics. Some of these derivatives were demonstrated and illustrated to have unique physical properties like photo & electro-luminescence, liquid crystallinity, electric conductivity and non-linear optics. Polymers with carbazole ring are sub-divided into two categories, namely those with carbazole group in main chain and the other with the side chain. In the latter group some polymers contain carbazole attached by nitrogen and others in which the carbazole ring is bonded via carbon. The side chain length between main chain and carbazole is crucial for physicochemical properties like phase transition temperature, solubility in organic solvents, formation of charge transfer complexes and non-linear optical properties. The synthesis of multifunctional oligoetherols with carbazole ring was not reported till now. High thermal resistance of carbazole renders it useful substrate to increase thermal stability of oligoetherols and polymers obtained from them, like polyurethanes and polyesters. Thus, the linear oligoetherols were obtained from carbazole and epichlorohydrin leading to 9-(2,3-epoxypropyl) carbazole (EPC) followed by epoxide ring opening upon reaction with water or ethylene glycol or on alternative route by reaction of carbazole with ethylene chloride and further conversion of semiproduct by dietanolamine to give diol, that was finally converted to oligoetherol by reaction with oxirane excess. All obtained oligoetherols showed high thermal resistance. When propylene glycol was replaced by 3-(9-carbazoil)propane-1,2-diol in synthesis of polyester resin, the obtained polymer indicated remarkable increase in thermal stability.

The polyurethane foams obtained till now were thermally stable up to storage at 150°C. The exposure of foams to 200°C can result in dimension and shape changes of samples. Probably the reason was too low functionality of used oligoetherols with carbazole ring that were tri-functional. Therefore, the derivative of carbazole with more hydroxyl groups to obtain polyurethane foams enhanced the thermal stability. Hexafunctional oligoetherols with carbazole ring could be obtained from carbazole and glycerine epichlorohydrin to get 9-(2,3-epoxypropyl) carbazole. Its epoxide ring opening can be performed by reaction with sorbitol, the product can further be converted to oligoetherols by its reaction with oxiranes. Obtained oligoetherols have similar properties to typical polyols used for polyurethane foam preparation except much higher thermal stability. Polyurethane foams obtained from polyfunctional oligoetherols with carbazole ring have remarkable thermal resistance demonstrated on long-time exposure to 200°C. These developmental studies of thermally resistant polymers would render better scientific applications in future.

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