

**Bong Sup Kim**

**New Isoconversion and Isoviscosity Time-Temperature-Transformation Cure Diagrams of Tetrafunctional Epoxy Resin/Poly(ether sulfone) Blend**

**Korea Polymer Journal, 3(2), 57(1995)**

For the cure process of a tetrafunctional epoxy resin/poly(ether sulfone)/dicyandiamide, we established new isoconversion and isoviscosity TTT(time-temperature-transformation) cure formulae. The transformation here involves isoconversion and isoviscosity contours besides gelation, vitrification and phase separation. The conversion was characterized by d.s.c., the viscosity was by viscoelastic measurement and the phase separation process was by light scattering and scanning electron microscopy. The phase separation took place at lower conversions and corresponding lower viscosities. Two-phase structure is established via spinodal decomposition mode and the phase-separated structure is nearly fixed by gelation. The gelation occurred at a conversion of ca. 45-50% and a viscosity of  $10^4$  poise over the entire cure temperatures. The periodic distance,  $\Delta m$ , in the phase-separated structure changed; the lower the cure temperature, the shorter the periodic distance. When the cure temperature was high, a bicontinuous two-phase structure was obtained. For a low temperature cure system, the spherical domain structure is realized.

**Jong Wook Shin, Hyo Jin Kim, Won Ho Jo,**

**Jae-Min Hong, Bumsuk Jung, and Yong Soo Kang**

**Gas Permeation Characteristics in Polyarylate/Poly(butylene terephthalate) Blend Membranes**

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The permeation properties of oxygen and nitrogen in polyarylate (PAR)/poly(butylene terephthalate) (PBT) blend membranes were investigated and analyzed by using a modified two-phase model. PAR and PBT are amorphous and semi-crystalline polymers, respectively, and the amorphous phases of these polymers form a miscible blend. When blended, these two polymers show a volume contraction. The effect of crystallinity on gas permeation and separation properties was also examined. The crystallinity was con-

trolled by annealing and/or by varying its PBT content. The resulting gas permeation characteristics were analyzed by using the modified two-phase model, derived from the semi-logarithmic additive rule. The experimental permeability in the amorphous phase of the blend showed a marginally negative deviation from the model. The deviation may be attributable to the volume change during blending.

**Jin-Gon Jeong, Chang-Sik Ha, and Won-Jei Cho**  
**Synthesis, Characterization and Biological Activity of Furan-Maleic Anhydride-Vinylacetate Terpolymer by Thermal Copolymerization of 3,5-Dioxo-4,10-dioxatricyclo[5.2.0]dec-8-ene and Vinylacetate**

**Korea Polymer Journal, 3(2), 71(1995)**

Copolymerizations of 3,5-dioxo-4,10-dioxatricyclo[5.2.0<sup>2,6</sup>]dec-8-ene(DDTD) with vinylacetate(VAc) were carried out in 2-butanone using AIBN as an initiator at 50°C for 48 hrs. IR, <sup>1</sup>H-NMR and <sup>13</sup>C-NMR spectra of polymer obtained by a copolymerization were consistent with those of furan-maleic anhydride-vinylacetate terpolymer[terpoly(F-MAH-VAc)] which was prepared by terpolymerization of corresponding monomers such as furan(F), maleic anhydride(MAH) and vinylacetate(VAc). Prepared terpoly(F-MAH-VAc) showed polyelectrolyte viscosity behavior at low concentration in water or DMF. Average molecular weight of terpoly(F-MAH-VAc)s prepared under initiator concentration of 1,4 and 8 mol.% were 23,400, 19,500 and 7,200, respectively. NK activities of terpoly(F-MAH-VAc) and 5-fluorouracil(5-FU) were evaluated *in vitro*. The NK activity of terpoly(F-MAH-VAc) was better than that of 5-FU.

**Youngchul Lee, Ho Woong Choi, In-Joo Chin, H. Y. Won, and Y. S. Kim**

**Conversion of Poly(methyl methacrylate) to Polyglutarimide**

**Korea Polymer Journal, 3(2), 76(1995)**

Polyglutarimides (PGI) were obtained by reacting poly(methyl methacrylate)(PMMA) with various primary amines in an autoclave. The degree of imidization, which was determined by <sup>1</sup>H-NMR spectroscopy, ranged from 40 to 70 %, and the PMMA

modified by methyl amine showed a nearly complete imidization. Glass transition temperatures of most PGI's were much higher than that of PMMA. The glass transition temperature of PGI was increased as the alkyl group of the primary amine became shorter and bulkier. Also, thermogravimetric analyses indicated that the thermal stability of the modified PMMA was significantly improved as a result of the imidization except for PMMA modified by isopropyl amine, tert-butyl amine and benzyl amine.

**Dong Kook Kim, Kyung-Tae Kim, and Young-Wook Chang**

**Preparation of Polymer-Microencapsulated Calcium Carbonate by Suspension Polymerization**  
**Korea Polymer Journal, 3(2), 82(1995)**

Suspension polymerization method was employed to encapsulate calcium carbonate particles with PMMA and PS. FT-IR spectra and scanning electron micrographs indicated that the polymeric wall materials were well formed by the suspension polymerization as the monomer contents in the reactant mixtures increased. The polymerization percentage, determined by thermal combustion method, was 86, 88, 90% and 58, 98, 89% for the PMMA- and PS-encapsulated calcium carbonate particles respectively, when the ratio of  $\text{CaCO}_3$  particle to each monomer was changed from 4 : 1, 2 : 1 to 1 : 1.

**Seung-Won Song and John M. Torkelson**  
**Phase Separation Phenomena in Polystyrene Solutions**

**Korea Polymer Journal, 3(2), 86(1995)**

The phase separation phenomena in polymer solutions were studied *via* phase diagrams of polystyrene-solvent systems determined by differential scanning calorimetry and turbidimetry method. It was demonstrated that the critical temperatures found in this study and the theta temperatures from the research literature, show a linear relationship as expected from the Shultz-Flory equation. Thermally induced phase separation (TIPS) process was employed to prepare microporous membranes, and the phase separation mechanisms were studied based on the phase diagram for the system. It has been shown that if polymer concentration is close to the critical point and phase separation is initiated in the unstable region, resulting in a spinodal decomposition mechanism, the membrane produced was well interconnect-

ed with highly uniform pore sizes and possesses mechanical strength. In contrast, the characteristic membrane morphology associated with polymer concentration being below the critical concentration and phase separation being initiated in the metastable region, resulting in a nucleation and growth mechanism, was a poorly interconnected, stringy and/or beady structure which is mechanically fragile.

**Doo-Hwan Dan and Dong Choo Lee**  
**Synthesis and Molecular Characterization of Bisphenol A Poly(iminocarbonate)**  
**Korea Polymer Journal, 3(2), 94(1995)**

Synthesis and molecular characterization of bisphenol A poly(iminocarbonate) were carried out. A successive precipitational fractionation and size exclusion chromatography measurement yielded well defined fractions whose molecular masses varied from 4,000 to 62,300 g/mol. Dilute solution viscometry in both the systems of  $\theta$ -composition and DMF at 30°C confirmed the viscosity-molecular mass relationship is well outside the Gaussian behavior. The chain parameters found on the basis of wormlike cylinder model were;  $M_c = 473 \text{ nm}^{-1}$ , persistence length  $q = 1.8 \text{ nm}$ , and cylinder diameter  $d = 0.92 \text{ nm}$ , which appeared slightly higher than those of bisphenol A polycarbonate. These led to a conclusion that the chains can be regarded as semiflexible with less stiff chain character.

**Jae Ho Kim, Tae Ki Park, Hoosung Lee, and Dong Jae Lee**

**Pyroelectricity in Poly(vinylidene fluoride) and Poly(vinylidene fluoride-co-tetrafluoroethylene) Synthesized with Various Initiators**  
**Korea Polymer Journal, 3(2), 101(1995)**

Pyroelectric coefficients of PVDF and P(VDF-TFE) synthesized with di-*tert*-butyl peroxide (DTBP), ammonium persulfate (APS), or diisopropyl peroxydicarbonate (IPP) as initiator are compared in conjunction with the content of the polar crystalline phase in the polymers. PVDF synthesized with APS shows higher pyroelectricity than PVDF synthesized with DTBP at all temperatures tested. This is due to higher content of  $\beta$ -crystalline phase in PVDF synthesized with APS than that synthesized with DTBP as was revealed by X-ray diffraction and DSC measurements. When synthesized using the same initiator, P(VDF-TFE) always shows higher pyroelec-

tricity than PVDF in the tested range of TFE content. This is also due to the higher  $\beta$ -crystalline content in the copolymer as was revealed by DSC and X-ray diffraction.

**Jae-Kyeung Park, Hyun Kuk Choi, and Takeshi Endo**

**Cationic Ring-Opening Polymerization of 2-Isopropenyl-4-methylene-1,3-dioxolane at Ambient Temperature**

**Korea Polymer Journal, 3(2), 106(1995)**

Monomer of an unsaturated cyclic acetal having two carbon-carbon double bonds, 2-isopropenyl-4-methylene-1,3-dioxolane (I) has been synthesized from methacrolein and epichlorohydrin using *tert*-butoxide as a catalyst, and polymerized via cationic mechanism at ambient temperature. Linear soluble polymer containing pendant isopropenyl group, II, was obtained from the cationic polymerization systems initiated by  $\text{CH}_3\text{SO}_3\text{H}$  at temperatures ranging from 0 to 60°C in the presence of various nucleophilic additives or in the nucleophilic solvents. However, only crosslinked polymer, which is product of simultaneous propagation of two carbon-carbon double bonds in I, was obtained without nucleophilic additive. This behavior was explained in terms of the stabilization of cationic species due to the interaction of cationic species with nucleophile.

**Sangkug Lee**

**Synthesis and Characterization of Cyano-Substituted Polyimides. I**

**Korea Polymer Journal, 3(2), 111(1995)**

2,2'-Dicyano-4,4'-diaminobiphenyl(DCB) has been

synthesized from 2,2'-diiodo-4,4'-diaminobiphenyl and copper(I) cyanide. The initial polymerizations of this monomer with commercial dianhydrides in various solvents afforded insoluble materials. In order to improve the solubility, the random copolymerizations with a comonomer, 2,2'-bis(trifluoromethyl)-4,4'-diaminobiphenyl(PFMB), were carried out. Several copolymers, soluble in phenolic solvents, were obtained. Intrinsic viscosities ranged from 3.58 to 4.62 dL/g. The fiber with the highest tensile strength(17.9 g/d) was prepared from a copolymer obtained from a 1:9 molar ratio of DCB:PFMB.

**Sangkug Lee**

**Synthesis and Characterization of Cyano-Substituted Polyimides. II**

**Korea Polymer Journal, 3(2), 121(1995)**

Two different series of copolymers were prepared in one step by the reaction of 2,2'-dicyano-4,4'-diaminobiphenyl(DCB) with diamines. Two comonomers, 3,3'-dimethyl-4,4'-diamino biphenyl (OTOI) and 4,4'-diaminodiphenyl ether(ODA) were used. Several copolymers were obtained that were soluble in phenolic solvent. In the first series the intrinsic viscosities of the copolymers ranged from 4.66 to 6.72 dL/g. The copolymers were spun into fibers directly from their polymerization mixtures using dry-jet wet spinning process. The tensile strengths of the fibers were between 11.94 and 12.23 g/d and their moduli were between 780 and 877 g/d. In the second copolymerization study, the intrinsic viscosities of the copolymers were between 2.18 and 4.02 dL/g. Fibers of the copolymers displayed tensile strengths as high as 9.1 g/d and moduli as high as 230 g/d.