

Preparation of biodegradable polymers using CO₂: Poly(1,2-propylene carbonate), poly(1,4-butylene carbonate), poly(1,4-butylene carbonate-co-terephthalate)

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CO₂ can be utilized in polymer synthesis either as a monomer or as a raw material. A representative example is CO₂/propylene oxide copolymerization. We have developed a very efficient catalyst for this copolymerization, stimulating commercial trial. The CO₂/propylene oxide copolymer, poly(1,2-propylene carbonate) (PCC) exhibits attractive properties such as biodegradability, transparency, adhesiveness and green flammability, but it is an amorphous polymer with low T_g (~40 oC), which inhibits its widespread use. A related aliphatic polycarbonate, poly(1,4-butylene carbonate) (PBC), can be synthesized by condensation of 1,4-butandiol and dimethyl carbonate. Dimethyl carbonate is a bulk chemical synthesized using CO₂ as a raw material in Korea. PBC is a biodegradable semicrystalline polymer with T_m ~60 oC. Through incorporating some terephthalate units in PBC backbone, the T_m value increases above 100 oC. The resulting polymer, (poly(1,4-butylene carbonate-co-terephthalate), PBCT) exhibits thermal and mechanical properties similar to those of the commercial LLDPE with biodegradability advantage.