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Preparation of chlorinated poly(propylene carbonate) and its properties

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Carbon dioxide is an inexhaustible inexpensive chemical raw material, and it has been recently noted to fix carbon dioxide into a chemical material on a large scale. Since Inoue synthesized aliphatic polycarbonates having high molecular weight by using the copolymerization of carbon dioxide and an epoxy compound in 1969,¹ the study on the copolymerization of carbon dioxide and epoxy compounds has been continuously deepened and developed.² Nowadays, it become a research focus in the field of polymer sciences to synthesize polymer materials by using carbon dioxide as the raw material. For an example, poly(propylene carbonate) (PPC) as a typical biodegradable material is an alternating copolymer of carbon dioxide and propylene oxide,³ and has been put into the stage of industrial production. Recently, PPC was chlorinated in our laboratory by a gas-solid phase reaction (Figure 1).⁴ Ion chromatography and NMR tests showed that chlorine atoms were successfully introduced onto the PPC polymer chains. We named this new chlorinated polymer as chlorinated poly(propylene carbonate) (CPPC). It was worth noted that the chlorination reaction is quite warm at 60°C without any solvent and catalyzer, which is easily and simply realized for industrial production. It was found that the CPPC processed many more distinguished properties in solubility, wettability, adhesive, and gas barrier et al comparing to the PPC. For examples, the bonding strength of the CPPC as adhesive was nearly four times higher than that of the PPC on wood, stainless steel and glass by thermal bonding at 180°C. The oxygen permeability coefficient of the CPPC exhibits a decrease of 33% comparing to the PPC. Moreover, the CPPC kept good biodegradability. These results indicated that the CPPC could be widely used in coating, adhesive, barrier materials, and so on, which could greatly promote the development of PPC industry. This work was financially supported by the National Natural Science Foundation of China for General Program (51673195).

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