

论文

## 聚(丁二酸丁二酯-co-丁二酸丙二酯)的等温结晶行为研究

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**摘要** 以1,4-丁二酸、1,4-丁二醇和1,3-丙二醇为原料通过直接熔融缩聚法合成了聚丁二酸丁二酯(PBS),聚丁二酸丙二酯(PPS)和聚(丁二酸丁二酯-co-丁二酸丙二酯)(PBSPS)等脂肪族聚酯.利用 $^1\text{H-NMR}$ ,WAXD,DSC和POM等研究了聚酯的结晶结构和结晶动力学过程等结晶行为.PBSPS的结晶晶型与PBS一致,说明只有丁二酸丁二酯(BS)单元结晶而丁二酸丙二酯(PS)单元处于无定形区.聚酯等温结晶后,在升温熔融过程中出现了多重熔融峰.分析表明多重熔融峰主要来自于聚酯升温过程中的熔融-重结晶行为.利用Avrami方程分析了聚酯的等温结晶动力学,Avrami指数 $n$ 为2.2~2.8,说明聚酯等温结晶时主要以异相成核的三维生长方式进行;随着PS单元的增多,聚酯的表观结晶活化能升高,也就是说BS单元的结晶变得困难.POM观察到聚酯等温结晶时都出现了环带球晶现象,球晶形态会随着结晶温度和化学结构差异而改变.

**关键词** [聚\(丁二酸丁二酯-co-丁二酸丙二酯\)](#) [等温结晶](#) [结晶动力学](#) [环带球晶](#)

分类号

## CRYSTALLIZATION BEHAVIOR OF POLY(BUTYLENE SUCCINATE-co-PROPYLENE SUCCINATE)S

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**Abstract** Bidegradable polyesters based on 1,4-succinic acid and different ratios of 1,4-butanediol and 1,3-propanediol units were synthesized from polycondensation of the appropriate mixture of the monomers. The crystal structure and melt crystallization kinetics of poly(butylene succinate-co-propylene succinate)(PBSPS)copolyesters have been investigated by means of  $^1\text{H-NMR}$ ,WAXD,DSC and POM. The copolyester composed of BS and PS units has been identified to have the same crystal structure as that of poly(butylene succinate)(PBS)homopolymer,suggesting that only PBS sequences crystallize while the PS units are in an amorphous form. Multiple melting peaks on the melting curves were observed during heating process,and DSC analysis has demonstrated that melt- recrystallization takes place during heating process. Isothermal crystallization kinetics of PBSPS has been analyzed by the well known Avrami equation. The 2.2—2.8 range of Avrami exponential values  $n$  of PBSPS in isothermal crystallization indicated that the mechanism of crystallization was a heterogeneous nucleation with spherical growth geometry. The banded spherulites were observed in PBSPS and the spherulitic morphology was affected by the crystallization temperature and the composition of copolyesters.

**Key words** [Poly \(butylene\) succinate-co-propylene succinate\)](#) [Isothermal crystallization](#)  
[Kinetics of crystallization](#) [Banded spherulites](#)

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