

研究论文

聚己内酯的等温与非等温结晶动力学研究

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摘要 采用示差扫描量热(DSC)与同步辐射小角X射线散射(SR-SAXS)技术分别研究了聚己内酯(PCL)的等温与非等温结晶动力学及等温结晶过程中PCL片层结构的变化. 在等温结晶过程中, Avrami指数 $n \approx 3$, 表明PCL以异相成核的三维球晶方式生长. 同时计算了折叠链表面自由能等结晶动力学参数. 在非等温结晶的过程中, Avrami指数 $n \approx 4$, 表明PCL以均相成核的三维球晶方式生长. 同步辐射小角X射线散射数据分析表明, 在等温结晶过程中, 长周期与非晶层的平均厚度随着结晶时间的增加会经历先减小后几乎不变的过程, 而结晶层的平均厚度不随结晶时间变化而变化. 同时随着结晶温度的升高, 长周期、结晶层厚度与非晶层厚度等片层结构参数均增加.

关键词 [聚己内酯; 等温与非等温结晶动力学; 片层结构](#)

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Investigation on Isothermal and Non-isothermal Crystallization Kinetics of Poly(ϵ -caprolactone)

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Abstract The crystallization kinetics and the development of lamellar structure during the isothermal crystallization of poly(ϵ -caprolactone)(PCL) were investigated by means of differential scanning calorimetry(DSC) and real-time synchrotron small angle X-ray scattering(SR-SAXS) techniques, respectively. The Avrami analysis was performed to obtain the kinetics parameters. The value of Avrami index, n , is about 3, demonstrating a three-dimensional spherulitic growth on heterogeneous nuclei in the process of isothermal crystallization. The activation energy and the surface free energy of chain folding for isothermal crystallization were determined according to the Arrhenius equation and Hoffman-Lauritzen theory, respectively. In the process of nonisothermal crystallization of PCL, the value of Avrami index, n , is about 4, which demonstrates a three-dimensional spherulitic growth on homogeneous nuclei. In addition, lamellar parameters were obtained from the analysis of SR-SAXS data. The results indicate that long period and the thickness of amorphous layer first decrease and then keep constant with the increase of the crystallization time. At the same time, the long period increases with increasing the crystallization temperature, which is the same as the thickness of amorphous and crystalline layers.

Key words [Poly\(\$\epsilon\$ -caprolactone\)](#) [Isothermal and nonisothermal crystallization kinetics](#) [Lamellar structure](#)

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