高等学校化学学报 2010, 31(2) 397-401 DOI: ISSN: 0251-0790 CN: 22-1131/O6

论文

长链支化聚乳酸的多重松弛行为

汪永斌[1,2], 牛艳华[1], 杨靓[1,2], 于逢源[3], 张洪斌[3], 王志刚[1]

1. 中国科学院化学研究所, 工程塑料重点实验室, 北京 100190;
2. 中国科学院研究生院, 北京 100049;
3. 上海交通大学化学化工学院, 上海 200240

摘要:

在辐照法制备长链支化聚乳酸(LCB-PLA)的基础上, 采用凝胶渗透色谱-多角度激光光散射联用(SEC-MALLS)表征了LCB-PLA的支化结构, 利用动态流变学方法考察了PLA的黏弹松弛行为, 计算得到了线型及支化PLA在较宽时间范围内完整的加权松弛时间谱. 结果表明, 由于长支链的引入及支链长度的增加, 导致LCB-PLA松弛时间谱加宽, 松弛时间增长, 并呈现多重松弛行为. 提出了一种计算长链支化聚合物支链长度的方法, 可以定量表征LCB-PLA的支链长度以及长支链的分子量.

关键词: 聚乳酸; 长链支化; 剪切流变学; 多重松弛行为; 支化度

Multiple Relaxation Behavior of Long Chain Branched Polylactic Acid

WANG Yong-Bin[1,2], NIU Yan-Hua[1], YANG Liang[1,2], YU Feng-Yuan[3], ZHANG Hong-Bin[3], WANG Zhi-Gang[1*]

1. Key Laboratory of Engineering Plastics, Institute of Chemistry, Chinese Academy of Sciences, Beijing 100190, China;
2. Graduate School of Chinese Academy of Sciences, Beijing 100049, China;
3. School of Chemistry and Chemical Engineering, Shanghai Jiaotong University, Shanghai 200240, China

Abstract:

The long chain branched polylactic acid(PLA) samples were successfully fabricated by high energy irradiation in the presence of a small amount of poly-functional monomer. The branched structures of PLA were convinced by size exclusion chromatography(SEC) coupled with a multi-angle laser light scattering(MALLS). By the means of oscillatory shear and creep measurements, the shear rheological behavior of branched PLA was investigated. Meanwhile, the weighted relaxation spectra of PLA were calculated in light of the combined dynamic modulus data. The multiple relaxation behavior of PLA, which was attributed to the existence of different lengths of long chain branches, was actually observed. In addition, a novel procedure for quantificational determination of the lengths of branches and the arm molecular weight of PLA was put forward. It was found that the lengths of branches of PLA were extended and the arm molecular weight was enhanced with increasing amount of poly-functional monomer. The above results could facilitate the fabrication of long chain branched PLA with well-controlled branched structures and improved rheological properties that may dominate the future bio-plastics industry.

Keywords: Polylactic acid; Long chain branching; Shear rheology; Multiple relaxation behavior; Degree of branching

收稿日期 2009-05-05 修回日期 网络版发布日期

DOI:

基金项目:

国家自然科学基金重大项目(批准号: 10590355)资助.

通讯作者: 王志刚, 男, 研究员, 主要从事聚合物共混物和复合材料的流变学与形态学的研究. E-mail: zgwang@iccas.ac.cn

作者简介:

参考文献：

[1]McKee M. G., Unal S., Wilkes G. L., et al.. Prog. Polym. Sci.[J], 2005, 30: 507—539
[2]Drumright R. E., Gruber P. R., Henton D. E.. Adv. Mater.[J], 2000, 12(23): 1841—1846
[3]Langston J. A., Colby R. H., Chung T. C. M., et al.. Macromolecules[J], 2007, 40(8): 2712—2720
[4]Wyatt P.. J. Anal. Chim. Acta[J], 1993, 272(1): 1—40
[5]Yu Y. L., DesLauriers P. J., Rohlfing D. C.. Polymer[J], 2005, 46(14): 5165—5182
[6]Wood-Adams P. M., Dealy J. M.. Macromolecules[J], 2000, 33: 7481—7488
[7]Trinkle S., Walter P., Friedrich C.. Rheol. Acta.[J], 2002, 41(1/2): 103—113
[8]Wang Y. B., Wang Z. G.. Polym. Prepr.[J], 2008, 49(1): 91—92
[9]Zinn-Justin J., Guillou J. C. L.. Phys. Rev. Lett.[J], 1977, 39 : 95—98
[10]Auhl D., Stange J., Munstedt H., et al.. Macromolecules[J], 2004, 37 (25): 9465—9472
[11]Zimm B. H., Stockmayer W. H.. J. Chem. Phys.[J], 1949, 17: 1301—1314
[12]Krause B., Voigt D., Lederer A., et al.. J. Chrom. A[J], 2004, 1056(1/2): 217—222
[13]Kaschta J., Schwarzl F. R.. Rheol. Acta[J], 1994, 33(6): 517—529
[14]Kaschta J., Schwarzl F. R.. Rheol. Acta[J], 1994, 33(6): 530—541
[15]Gotsis A. D., Zeevenhoven B. L. F., Tsenoglou C.. J. Rheol.[J], 2004, 48(4): 895—914
[16]Kasehagen L. J., Macosko C. W., Trowbridge D., et al.. J. Rheol.[J], 1996, 40 (4): 689—709
[17]Stange J., Munstedt H.. J. Rheol.[J], 2006, 50(6): 907—923
[18]Tian J. H., Yu W., Zhou C. X.. Polymer[J], 2006, 47(23): 7962—7969
[19]Ferry J. D.. Viscoelastic Properties of Polymers[M], New York: Wiley, 1980
[20]Watanabe H.. Prog. Polym. Sci.[J], 1999, 24: 1253—1403
[21]Wu S.. J. Polym. Sci. Part B: Polym. Phys.[J], 1989, 27(4): 723—741
[22]Ball R. C., McLeish T. C. B.. Macromolecules[J], 1989, 22(4): 1911—1913

本刊中的类似文章

文章评论

反馈人		邮箱地址	
反馈标题		验证码	6698