

研究论文

聚酰亚胺/二氧化硅复合薄膜的热物性及其影响因素

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摘要:

应用自行研制的亚微米/微米薄膜激光脉冲法热扩散率测定仪和差示扫描量热仪(DSC)分别测定了聚酰亚胺(PI)薄膜和PI/SiO<sub>2</sub>复合薄膜在不同温度下的热扩散率、热导率和比热,解决了激光脉冲法测定热导试样的透光问题.研究了PI/SiO<sub>2</sub>复合薄膜的热物性随SiO<sub>2</sub>添加量和温度的变化关系.结果表明:随着温度的升高,PI薄膜及PI/SiO<sub>2</sub>复合薄膜的热扩散率下降,比热和热导率线性增加.在PI薄膜中添加SiO<sub>2</sub>颗粒可降低PI薄膜的比热,明显增强导热性能,但是不会改变PI薄膜热导率随温度升高而增大的变化规律.

关键词: 复合材料 热物性 激光脉冲法 PI/SiO<sub>2</sub>薄膜

Thermophysical properties and influencing factors of polyimide/silica composite films

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Abstract:

Thermal diffusivities, thermal conductivities, and specific heats of PI film and PI/SiO<sub>2</sub> composite film at different temperatures were measured by laser flash method and differential scanning calorimeter(DSC). The light transmission problem of thin films in the procession of testing thermal diffusivity by laser flash method was solved effectively. The influences of temperature and silica content on thermophysical properties of PI/SiO<sub>2</sub> composite films were investigated. The results showed that thermal diffusivities of PI and PI/SiO<sub>2</sub> decreased, and specific heats and thermal conductivities increased with increasing temperature. The addition of the silica could result in the decrease of specific heats and the obvious enhancement of thermal conductivities, but the trend that the thermal conductivity of PI film increases with increasing temperature would not be changed, which is inherent in amorphous materials.

Keywords: composite material thermophysical properties laser flash method PI/SiO<sub>2</sub> thin film

收稿日期 2009-03-17 修回日期 2009-11-09 网络版发布日期 2009-12-25

DOI:

基金项目:

国家自然科学基金50706057资助项目.

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参考文献:

- [1] XIE Huaqing, XI Tonggeng, Thermophysics of Low Dimensional Materials (Shanghai, Scientific and Technology Press, 2008) p.1 (谢华清, 奚同庚, 低维材料热物理, 第一版, (上海, 上海科学技术文献出版社, 2008) p.1)
- [2] LIU Jingang, LI Zhuo, GAO Zhiqi, YANG Haxia, YANG Shiyong, Synthesis and properties of fluorinated semialicyclic transparent polyimide films for optocommunication applications, Chinese Journal of Materials Research, 22(6), 615(2008) (刘金刚, 李卓, 高志琪, 杨海霞, 杨士勇, 含氟半脂环透明聚酰亚胺薄膜的制备和性能, 材料研究学报, 22(6), 615(2008))
- [3] CHEN Xingui, GUO Jingdong, WANG Baoquan, HE Guanhu, Thermal diffusivity research of PI/SiO<sub>2</sub> films by flash method, Polymer Materials Science & Engineering, 25(4), 109(2009) [crossref](#) (陈新贵, 郭敬东, 王宝全, 何冠虎, 激光脉冲法研究半透明PI/SiO<sub>2</sub>薄膜的热扩散率, 高分子材料科学与工程, 25(4), 109(2009))
- [4] C.L.Choy, W.P.Leung, Y.K.NG, Thermal Diffusivity of Polymer Films by the Flash Radiometry Method, Journal of Polymer Science: Part B: Polymer Physics, 25, 1779(1987) [crossref](#)
- [5] J.K.Cocson, C.S.Hua, P.M.Lee, C.C.Poon, A.H.Zhong, J.A.Rogers, K.A.Nelson, Characterization of 6FDAAPBP polyimide films through impulsive stimulated thermal scattering, Journal of materials science, 30, 5960(1995) [crossref](#)
- [6] XI Tonggeng, Thermophysics Properties of Inorganic Material, (Shanghai, Scientific and Technology Press, 1981) p.173

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本文关键词

- ▶ 复合材料
- ▶ 热物性
- ▶ 激光脉冲法
- ▶ PI/SiO<sub>2</sub>薄膜

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(奚同庚, 无机材料热物性学, 第一版, (上海, 上海科学技术文献出版社, 1981) p.173)

- [7] XI Tonggeng, ZHOU Xinyu, LI Zongjie, NI Helin, GU Zongyi, Computerized laser thermal diffusivity measurement apparatus, Journal of Engineering Thermophysics, 1(2), 147(1980)  
(奚同庚, 周新宇, 李宗杰, 倪鹤林, 顾宗义, 计算机运控的激光热导仪的研究, 工程热物理学报, 1(2), 147(1980))
- [8] A.Cai, , H.Q.Xie, T.G.Xi, in Proceedings of the 8th Asian Thermophysical Properties Conference, Thermal Diffusivity Measurement of Nano/micro-scale Thin Films by Nano-second Laser Flash Technique from -50 to 200 °C, (Fukuoka, Kyushu University, , (2007) [crossref](#))
- [9] Y.S.Touloukian, R.W.Powell, C.Y.Ho, M.C.Nicolaou, Thermophysical properties of Matter, Vol.10, (New York, Plenum Press, 1973) p.120
- [10] Y.J.Song, S.H.Meng, F.D.Wang, C.X.Sun, Z.C.Tan, Thermochemical study on the properties of polyimide BPADAm- PDA, Thermochimica Acta, 389, 19(2002) [crossref](#)

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1. 田晓滨;赵晓鹏;周本濂.短纤维增强复合材料的仿生模型—I 哑铃状短纤维增强复合材料的应力分析[J]. 材料研究学报, 1994,30(16): 180-186
2. 岳广全 戴福洪 杜善义 张博明.热固性复合材料加筋壁板三维固化模拟[J]. 材料研究学报, 2010,26(05): 467-471
3. 秦孝华; 范存淦; 韩维新; 戎利建; 李依依 .液态机械搅拌法制备陶瓷颗粒增强铝基复合材料[J]. 材料研究学报, 2002,38(8): 885-887
4. 刘希从;魏克泰.Nicalon SiC/Al复合材料中的界面反应[J]. 材料研究学报, 1988,24(2): 183-188
5. 姜文标;刘友鹏;舒光冀.铝液对石墨润湿过程的研究[J]. 材料研究学报, 1988,24(2): 214-217
6. 任志锋;张承甫.共晶自生复合材料的晶形转变[J]. 材料研究学报, 1988,24(4): 365-367
7. 郭树启;韩圭焕;姚忠凯.SiC\_w/Al复合材料的微观结构与性能[J]. 材料研究学报, 1988,24(6): 499-504
8. 曹利;蒋持平;姚忠凯;雷廷权.碳化硅晶须增强铝复合材料的断裂研究[J]. 材料研究学报, 1989,25(3): 113-118
9. 梁民宪;夏非.TiB<sub>2</sub>-B<sub>4</sub>C陶瓷复合材料的微观组织和机械性能[J]. 材料研究学报, 1989,25(3): 107-112
10. 张劲松;夏非;罗川;曹丽华;赵宽放;胡宛平.ZTA-SiC\_w的显微结构与断裂特征[J]. 材料研究学报, 1989,25(6): 136-142