

## 研究论文

### 玻璃纤维增强气凝胶的动态力学性能及其破坏机理

杨杰, 李树奎

北京理工大学材料科学与工程学院 北京 100081

摘要:

使用Hopkinson 压杆对玻璃纤维增强气凝胶进行动态压缩实验, 用扫描电子显微镜研究气凝胶破坏机理. 结果表明, 气凝胶的动静态应力应变曲线均包括弹性区、屈服区和致密化区, 气凝胶在屈服区出现塑性屈服的特征. 气凝胶的应变率强化效应明显. 气凝胶对入射波的整形作用导致输入杆承载应力的幅值明显降低, 承载应力的时间延长. 在高应变率条件下, 气凝胶中的玻璃纤维几乎全部断裂, 与基体分离, 气孔急剧收缩. 气凝胶在动态压缩下的粉碎破坏是气凝胶轴向压应力和内部横向张应力升高所共同导致的.

关键词: 无机非金属材料 玻璃纤维增强气凝胶 动态力学性能 微观分析 破坏机理

### Research on the dynamic mechanical property and failure mechanism of glass fiber reinforced aerogel

YANG Jie, LI Shukui

School of Materials Science and Engineering, Beijing Institute of Technology, Beijing 100081

Abstract:

The dynamic mechanical property of glass fiber reinforced aerogel was investigated using a split Hopkinson pressure bar. Failure mechanism of aerogel was studied by scanning electron microscopy (SEM). The result showed that the quasi-static and dynamic stress-strain curves contained three regions: an elastic region, a yield region and a densification region. In the yield region, the compressive stress-strain curve showed plastic yield characteristics. The compressive behaviors of aerogel displayed a remarkable strain rate strengthening effect. Incident wave shaping using aerogel led to the decrease of stress on the incident bar and the increase of stress duration time on the incident bar. Under high strain rates, the glass fibers broke down and separated from matrix, and the pores shrank rapidly. Failure was due to the increase of axial compressive stress and lateral tensile stress under dynamic compression.

Keywords: inorganic non-metallic materials glass fiber reinforced aerogel dynamic mechanical property micro-analysis failure mechanism

收稿日期 2009-01-19 修回日期 2009-07-31 网络版发布日期 2009-10-10

DOI:

基金项目:

国防预研基金151241资助项目.

通讯作者: 杨杰

作者简介:

作者Email: seaman@bit.edu.cn

## 参考文献:

- 1 G.W.Scherer, Characterization of aerogels, *Advances in Colloid and Interface Science*, 76-77, 321 (1998)
- 2 Atul Katti, Nilesh Shimpi, Samit Roy, Chemical, physical, and mechanical characterization of isocyanate cross-Linked amine-modified silica aerogels, *Chemistry of Materials*, 18, 285(2006)
- 3 LIU Jianfei, WANG Zhengdao, HU Shisheng, The SHPB experiment technology for low wave impedance porous materials, *Journal of Experimental Mechanics*, 13, 219(1998)  
(刘剑飞, 王正道, 胡时胜, 低阻抗多孔介质材料的SHPB实验技术, *实验力学*, 13, 219(1998))

扩展功能

本文信息

- ▶ Supporting info
- ▶ PDF(952KB)
- ▶ [HTML全文]
- ▶ 参考文献[PDF]
- ▶ 参考文献

服务与反馈

- ▶ 把本文推荐给朋友
- ▶ 加入我的书架
- ▶ 加入引用管理器
- ▶ 引用本文
- ▶ Email Alert
- ▶ 文章反馈
- ▶ 浏览反馈信息

本文关键词相关文章

- ▶ 无机非金属材料
- ▶ 玻璃纤维增强气凝胶
- ▶ 动态力学性能
- ▶ 微观分析
- ▶ 破坏机理

本文作者相关文章

- ▶ 杨杰
- ▶ 李树奎

PubMed

- ▶ Article by Yang,j
- ▶ Article by Li,S.K

4 L.Blaz, E.Evangelista, Strain rate sensitivity of hot deformed Al and AlMgSi alloy, Materials Science and Engineering A, 207, 195(1996)

5 T.Mukai, H.Kanahashi, T.Miyoshi, Experimental study of energy absorption in a closed-celled aluminum foam under dynamic loading, Scripta Materialia, 40, 921(1999)

6 L.J.Gibson, M.F.Ashby, Cellular Solids: Structure and Properties, 2nd ed., (Cambridge, Cambridge University Press, 1997) p.153

7 H.Luo, H.Lu, N.Leventis, The compressive behavior of isocyanate-crosslinked silica aerogel at high strain rates, Mechanics of Time-Dependent Materials, 6, 83(2006)

本刊中的类似文章

1. 杨振明, 张劲松, 曹小明, 李峰, 徐志军 .用柠檬酸溶胶-凝胶法制备三效催化剂[J]. 材料研究学报, 2003,17(4): 0-374
2. 冯+C3419奇 , 巴恒静, 刘光明 .二级界面对水泥基材料孔结构和性能的影响[J]. 材料研究学报, 2003,17(5): 0-494
3. 陈岁元, 刘常升, 张雅静, 才庆魁 .激光辐照丙酮溶液中固体靶制备纳米碳粉[J]. 材料研究学报, 2003,17(5): 0-498
4. 张栋杰, 都有为 .Fe2O3对锌铁氧体隧道结构和磁性能的影响[J]. 材料研究学报, 2004,18(1): 34-
5. 顾四朋, 侯立松, 赵启涛 .Sn掺杂Ge--Sb--Te相变薄膜的晶化特性[J]. 材料研究学报, 2004,18(2): 181-186
6. 刘旭东, 曹小明, 张洪延, 张劲松 .三维连通网络碳化硅的电特性[J]. 材料研究学报, 2004,18(4): 365-372
7. 刘旭东, 邹智敏, 曹小明, 张洪延, 张劲松 .铅酸蓄电池三维网络碳化硅板栅和极板内电流的分布[J]. 材料研究学报, 2004,18(6): 587-592
8. 马兆昆, 刘杰 .碳纤维表面特性对兼性及厌氧微生物固着的影响[J]. 材料研究学报, 2004,18(1): 60-
9. 黄苏萍, 周科朝, 刘咏 .羟基磷灰石晶体在有机膜上的受控生长[J]. 材料研究学报, 2004,18(1): 66-
10. 朱嘉琦, 孟松鹤, 韩杰才, 檀满林 .衬底偏压对四面体非晶碳薄膜结构和性能的影响[J]. 材料研究学报, 2004,18(1): 76-

文章评论

反 馈 人	<input type="text"/>	邮 箱 地 址	<input type="text"/>
反 馈 标 题	<input type="text"/>	验 证 码	<input type="text" value="7665"/>