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多向铺层碳/环氧复合材料特性及声发射分析

洗杏娟, 蒋灿兴

中国科学院力学研究所

FAILURE BEHAVIOUR AND ACOUSTIC EMISSION ANALYSES OF MULTI-PLY CARBON/EPOXY COMPOSITE MATERIALS

Xian Xingjuan, Jiang Conxing

Institute of Mechanics, Academia Sinica

摘要 | 参考文献 | 相关文章

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摘要 本文对六种多向铺层的碳纤维增强环氧复合材料的拉伸破坏性能进行了研究,并采用声发射技术监测其损伤扩展过程,分析了它们的破坏机理。 新型的高性能碳纤维增强环氧复合材料应用于宇航、机械及体育器具等,由于工作条件及受力情况是复杂的,采用多向铺层才能满足受拉、压、弯、剪、扭等不同载荷的分别组合,具体铺层设计要针对主要承力情况来确定。多向铺层复合材料的损伤破坏比单向铺层的情况复杂,更需要采用试验的手段来研究它们的力学性能和破坏机理。在非破坏性测试中声发射技术的特点在于能够配合加载装置在进行试验过程中检测并记录复合材料的破坏过程,而且不移动探头的位置即可监测材料的较大区域,因此应用愈来愈多。声发射技术是利用材料或构件受力变形或损伤过程中应变释放产生弹性波这一原理来检测材料的缺陷、退化和破坏,评定材料的性能。声发射技术可以检测复合材料的剪切破坏及拉伸屈服破坏、分层及纤维断裂、粘接强度等。 本工作对六种多向铺层碳/环氧复合材料（包括0/90、±45°、30/60和三种碳布）进行拉伸试验,确定了它们的强度、模量、最大应变率及泊松比,给出六种不同铺层的应力应变关系以及声发射信号量的关系。采用声发射技术配合显微镜观测手段分析不同铺层的碳/环氧材料的声发射表征

关键词：

Abstract： The tensile failure behaviours of six multi-ply carbon/epoxy composites （[0/90]s, [±45]s, [30/60] and three kinds of carbon cloths） have been investigated. Acoustic emission technique was employed in monitoring their damage process together with microscopical observation.The occurrence of acoustic emission weighted ringdown signals indicate the release of strain energy at the initial damage of the composite materials. Generally, for [±45]s, [30/60] ply and transverse carbon cloths specimens whose stress-strain curves all have an inflection, initial damage acoustic emission signals occur al this location, for most of them in the vicinity of 40% ultimate strength and maximum strain. Their maximum weighted ringdown counts are of the same order of magnitude, but their total A. E. weighted ringdown counts differ magnificantly. This shows that the total energy of damage released is quite different for the differently plied composites. Due to deformation and damage, the A. E. pattern of the carbon cloth specimen demonstrates continuous energy release, but that of bidirectionally plied specimen shows discontinuity. The A. E. signals of cross-ply specimen occur at regular intervals with little change in the amplitudes of the weighted ringdown signals. This indicates homogeneous orthotropy for [0/90]s specimens. However, for [±45]sand [30/60] specimens energy release is concentrated at the final stage.

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