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典型结构功能一体化复合材料的设计与制备技术



分享本文

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摘要: 在碳纤维增强树脂基复合材料轻量化与结构性能持续提高的前提下, 同时附加其特定的功能, 尤其是在不损失、甚至提升其层间断裂韧性的情况下, 不仅可以弥补结构复合材料天然的缺陷, 例如树脂基体的电绝缘性, 也可以使其满足特定产品的要求, 例如高刚度兼具一定的吸声降噪特性等。显然, 对于航空航天这样的尖端应用领域, 这种功能附加或结构功能一体化的复合材料技术对航空航天技术的未来发展至关重要。本文介绍了 4 种具有典型性的结构功能一体化复合材料的设计、制备与性能研究, 分别是基于层间功能化插层和基于内织导电纬纱的导电增韧一体化复合材料及多级孔碳化棉纤维填充蜂窝/微穿孔面板的夹芯复合材料结构和编织布/无纺纤维毡复合材料片材折叠成型的结构吸声一体化复合材料。前两种材料分别通过在复合材料富树脂的层间插入导电功能化插层和在复合材料内引入贯通整个材料的导电纬纱网络实现了复合材料的导电性能与层间韧性的同步提高, 而后两种材料则分别通过多级孔结构的碳化棉纤维材料填充蜂窝/微穿孔面板夹芯技术和编织布/无纺纤维毡复合材料片材的折叠技术实现了良好的吸声性能等, 以展示多尺度、多层次结构设计和制备技术在结构复合材料功能化集成和结构功能一体化方面的应用。

关键词: 碳纤维复合材料; 多功能复合材料; 导电; 增韧; 吸声

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Design and fabrication techniques for typical structural-functional integrated composites

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Abstract: Under the premise of continuous improvement of lightweight and structural performance of carbon fiber reinforced polymer matrix composites, enhancing specific functions, especially in the case of no loss, or even enhancement of their interlaminar fracture toughness, can not only compensate for the inherent shortcomings of structural composite materials, such as the electrical insulation of the resin matrix, but also enable them to meet the requirements of specific products, such as high stiffness and certain sound absorption and noise reduction properties. Obviously, for cutting-edge applications such as aerospace, such function-added or structure-function-integrated composites technology is crucial to the future development of aerospace technology. In this paper, the design, preparation, and performance studies of four typical function-integrated structural composites are presented, which are conductivity-toughening integrated laminate based on functionalized interleaf technology (FIT), and based on Inter-Woven Conductive Weft Fabric (IWCWF); Sound absorption composite based on honey-

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