Smart Materials for Aerospace Sensing: Development & Prospects

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The aviation industry stands as a testament to human ingenuity, continually pushing the boundaries of innovation to achieve greater efficiency, safety, and performance. When it comes to improving aircraft design, functionality, and operational capabilities, the incorporation of smart materials becomes increasingly important as technological breakthroughs transform aviation. Smart materials (e.g., piezoelectric materials, shape-memory materials, and giant magnetostrictive materials) have unique physical properties and excellent integration properties, and they perform well as sensors or actuators in the aviation industry, providing a solid material foundation for various intelligent applications in the aviation industry [1]. This abstract offers an overview of the state of smart materials in aerospace sensing through a thorough analysis of current developments and case examples. It highlights the significance of these discoveries for aircraft performance, structural health monitoring, and environmental sensing. It looks at significant advancements in manufacturing materials, sensing techniques, and integration tactics. Since piezoelectric materials can transform mechanical energy into electrical impulses and vice versa, they are essential to aeronautical sensing. These materials find utility in sensing systems for energy harvesting, vibration, impact, and structural health monitoring in aerospace applications. They have emerged as the most researched materials for practical applications among the numerous smart materials [2]. Structural health monitoring (SHM) is a critical use case for piezoelectric materials in aerospace sensing. Guided-wave Structural Health Monitoring systems with piezoelectric sensors are investigated for localisation of barely visible impact damage in CFRP plates under vibration and different thermal conditions [3]. The incorporation of piezoelectric materials in aerospace sensing systems revolutionizes monitoring, detects anomalies early, and bolsters structural integrity. This advancement promises safer, more reliable, and more efficient aircraft and spacecraft operations. As research progresses, the potential for piezoelectric sensing technology to further elevate aerospace engineering is undeniable.

Keywords: Piezoelectric Materials, Aeronautical Sensing, Structural health monitoring

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