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Topic: Topological insulator, Bi_2Se_3 , and carbon fiber reinforced polymer heterostructure for electromagnetic interference shielding applications.

Abstract: Electromagnetic interference (EMI) forms an important issue in the aerospace industry as aircraft are under constant exposure to EMI from space, communication systems, and pieces of equipment around. This work shows the design of an EMI shield with the help of topological insulator coating on the carbon-fiber-reinforced polymer (CFRP). The CFRP is well known for its great potential strength, lightweight, non-corrosion, and excellent fatigue resistance, making it an important candidate material for the aviation industry. Bi_2Se_3 is a topological insulator known for its absorbing properties in the microwave frequency range. The deposition of thin films of Bi_2Se_3 on CFRP by magnetron sputtering with an RF source makes the layered structure, a good EMI shield that incorporates the mechanism of both reflection and absorption for attenuation of the incoming electromagnetic waves. The process is also cost-effective. The designed heterostructure of 10nm Bi_2Se_3 deposited on CFRP gave a shielding effectiveness of -64dB at a frequency of 27 GHz. The free-space focused beam method measured the shielding effectiveness in the frequency range of 26-40 GHz. The CFRP used were unidirectional and confirmed the anisotropic electrical behavior for the SE measurements when the incident signals were polarized along the direction of CFRP as well as perpendicular to it, giving a high degree of shielding effectiveness for signal polarized in the direction of CFRP fiber alignment.

Keywords

Electromagnetic Interference (EMI); Shielding Efficiency (SE); Carbon Fiber Reinforced Polymer (CFRP); Free space focused beam method.

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