ABSTRACT SUBMISSION
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Electromagnetic Shielding and Protection of Carbon-based Composites

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ABSTRACT
The report focused on electromagnetic shielding and protection of carbon-based composite materials. Particularly for the continuous carbon fiber reinforced polymers (CFRP) composites with prepreg stacked structures, they have anisotropic properties, including anisotropy of electrical conductivity and dielectric characteristics. These features lead to the founding of electromagnetic interference (EMI) shielding anisotropy of the CFRPs. Both the coaxial transmission line method and the specified designed free-space measurement system of the electromagnetic wave (EMW) technique were used to clarify the EMI shielding anisotropy of CFRP. Moreover, the optimization of EMI shielding performance of CFRP by changing the composites' structure were also investigated systematically. Laminated structures governed SE values, and the number of cross-layers in the composites improved their EMI shielding performance. The shielding mechanisms of cross-layer CFRPs were also discussed and clarified based on both experimental and theoretical analysis. We believe that these findings could provide a scientific basis and potential in designing high-performance EMI shielding materials.
Damages such as cracks and delamination are likely to occur in CFRP composites when subjected to external forces, such as impact and fatigue load. These damages are mostly invisible and cause safety hazards during the service of the products. Based on the founding of EMI shielding anisotropy and the EMI shielding effect, SE value, related to the damage degree in CFRPs as shown above, this report also proposes a new type of non-destructive testing (NDT) method using electromagnetic wave (EMW) technique, EMW-NDT. It was proven that the proposed EMW-NDT method is effective in detecting damages such as delamination, crack or other defects in CFRP composites. The EMW-NDT method's detection capacity to the delamination size, delamination thickness, and slits in CFRP composites was investigated. A reasonable sensitivity to the damage volume change in delamination was confirmed. The results confirmed that the proposed method demonstrates good detection sensitivity to delamination size and thickness. In terms of crack damage, the slit and its length were detected and the slit direction was successfully identified based on the characteristics of the electromagnetic interference (EMI) shielding anisotropy in CFRPs.