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Macroporous epoxy-carbon fiber structures with a sacrificial 3D printed polymeric mesh suppresses electromagnetic radiation

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ABSTRACT

Metals are known to be highly conducting and can shield electromagnetic waves quite well. In a quest to explore materials that are lightweight, corrosion free, easy to fabricate and integrate/embed, epoxy-carbon fiber composite structures have attracted a great deal of attention for myriad applications. Herein, we have fabricated macroporous structures involving epoxy and bi-directional carbon fiber (CF) for suppressing electromagnetic (EM) radiation, using 3D printed polymer mesh as a sacrificial layer in the laminate. This strategy reduces the weight of the composites by 15% besides retaining the EM blocking capability. In order to further enhance the shield-ability of the composite structures, ferromagnetic nanoparticles were electrodeposited directly on the bidirectional CF and infused with epoxy, using vacuum assisted resin transfer, and the 3D printed mesh. The latter was used as a sacrificial layer and was etched out from the final laminate structure to fabricate macroporous epoxy-CF laminates. The laminates with CF deposited with nickel on one side and cobalt on the other side showed better shielding manifesting in -40 dB (for 1.4 mm) as compared to other laminate structures. Upon etching the 3D printed mesh from the laminates, the resultant macroporous epoxy-modified CF laminates exhibited a shielding of -45 dB (for 1.4 mm thick) along with a thermal stability up to 200℃,