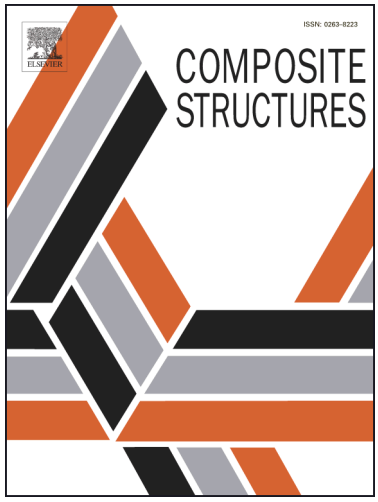

High-power laser resistance of filled sandwich panel with truss cores: ablation mechanisms and numerical simulation

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High-power laser resistance of filled sandwich panel with truss cores: ablation mechanisms and numerical simulation

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Abstract

A new function of filled sandwich panel with truss core, superior high-power laser resistance, is reported. When filled with carbon powder-reinforced silicone resin composite, which is an ablative material, the panel exhibits superior high-power laser resistance to monolithic plate with equal areal density. This paper revealed the detailed mechanisms and reproduced the process with numerical simulation. FIIR, SEM-EDS, and TG/DSC analyses on the virgin filler material and ablation residues are conducted to investigate the thermo-physicochemical process of the filler material during the laser ablation. Considering pyrolysis, oxidation, and phase change in the laser ablation process, a 3D numerical model is developed by using the finite element method. The temperature field and ablation morphology obtained from the numerical model agree with those from the experiment. The ablation evolution process, pyrolysis effect, and laser resistance mechanism of the filled sandwich panels with truss cores are evaluated based on the present model.

Keywords: Laser ablation, sandwich structure, ablative material, thermal-physical-chemical process, numerical simulation