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PROCEEDINGS

A Study of High Volume Fraction SiC/Al Composites Prepared by a Novel Hybrid Additive Manufacturing

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ABSTRACT

High-volume-fraction SiC/Al (HVF-SiC/Al) have a wide range of applications in aerospace, optics, automotive and electronic packaging. However, because the hardness, brittleness and wear resistance increase with the increase in the volume fraction, it is difficult for traditional methods such as machining, to process HVF-SiC/Al composites to complex components. Therefore, in this paper, a novel method of the hybrid additive manufacturing is proposed to fabricate HVF-SiC/Al parts with complex structures. The effect of polymer infiltration and pyrolysis (PIP) on microstructure and properties of HVF-SiC/Al composites is investigated. The results show that the mechanical properties of the SiC preforms can be effctively enhanced by the PIP process, and this enhancement makes the SiC preforms meet the conditions for subsequent vacuum pressure infiltration. The mechanical property of HVF-SiC/Al composites show a huge increase when in creasing the volume fraction of SiC. In particular, the flexural strength of HVF-SiC/Al composites increased from 202.28 MPa to 380.87 MPa, and the coefficient of thermal expansion (CTE) has also been reduced from 11.80 to 6.28 × 10-6/K, when the volume fraction of SiC increases from 42 to 80 vol%. For optimise the PIP process in the future, three theoretical models are used to predict the relationship between the CTE and the volume fraction of SiC. The results show that the experimental data are more consistent with the predicted values based on the Kerner's model, but deviate from the Rule-of-mixture (ROM) and Turner's models. Importantly, the complex-structures SiC/Al composite parts was successfully fabricated by this hybrid additive manufacturing.

KEYWORDS

Hybrid additive manufacturing; polymer infiltration and pyrolysis (PIP); vacuum pressure infiltration; high volume fraction SiC/Al composites

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