A NOVEL DIGITAL LIGHT PROCESSING TECHNOLOGY OF SHORT SiC FIBER REINFORCED SiC MATRIX COMPOSITES

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Abstract

The design and development of advanced ceramics and ceramic matrix composites for high-performance applications ranging from automotive to aerospace, defense-oriented, energy, environmental, and biomedical applications is one of the most challenging tasks of modern engineering. Among these, SiC fiber reinforced SiC matrix (SiC/SiC) composites are one of promising structural materials for nuclear energy and aerospace application due to their excellent properties such as lightweight, high strength, reliability under high temperature, low after heat, low radioactivity and so on. However, it is an incontrovertible fact that the wide use of SiC/SiC depends on the technological availability to fabricate near-net-shaped 3-D ceramic based composite parts with the required geometry. In this research, a novel digital light processing (DLP) technology, one of the most promising additive manufacturing technologies, is developed to fabricated complex shaped short SiC fiber reinforced SiC matrix composites, which will give an interesting future for additive

manufacturing of 3D shaped SiC/SiC composites.

Firstly, short SiC fiber and SiC matrix particles are homogeneously dispersed in a photosensitive resin. The zeta potential, Hamaker constant, rheological behavior and fluidity behavior are discussed by investigating the dispersant kinds, dispersant content, pH value, solid loading, and ball-milling parameters. Finally, a high solid loading short SiC fiber reinforced SiC ceramic suspension is obtained, and the as-prepared suspension is suitable for subsequent digital light processing (DLP).

Then, a novel digital light processing (DLP) technology, one of the most promising additive manufacturing technologies, is developed to fabricated complex-shaped short SiC fiber reinforced SiC matrix composites. A digital light processing (DLP) system is used to fabricated the SiC/SiC. The system is consisting of a x-y-z linear stage, an ultraviolet (UV) light, a digital micromirror device, a controller, and optics for light transfer. A 3D model is established and imported into the digital light processing (DLP) system. The effects of the light intensity, printing speed and time on the digital light processing (DLP) are studied in detailed. At last, a 3D complex shaped short SiC fiber reinforced SiC matrix composite component is successfully prepared.

Fig. 1 The SiC/SiC composite components prepared using DLP technology.

Finally, the as-prepared short SiC fiber reinforced SiC matrix composite specimens are pressureless sintered, and the effects of the sintering temperature, sintering soaking time, sintering additive and temperature rising speed on the density, microstructure and mechanical properties of the SiC/SiC composites are investigated.

The aim of this paper is to establish a novel digital light processing technology, one of the most promising additive manufacturing technologies, to fabricate 3D complex shaped ceramic based composites, and we believe this research can give some new insight of the fabricating technologies of ceramic based composites.

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