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Microstructure and mechanical properties of LPS-SiC based materials with oxide additives

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This paper dealt with the microstructure and the strength property of monolithic SiC and SiC\textsubscript{f}/SiC composite materials by the addition of oxide particles. SiC based materials were fabricated by a hot pressing process through a liquid phase sintering (LPS), using a commercial SiC powder with an average size of about 0.3 µm. The sintering additive was a Al\textsubscript{2}O\textsubscript{3}-Y\textsubscript{2}O\textsubscript{3} mixture with a constant composition ratio of Al\textsubscript{2}O\textsubscript{3} and Y\textsubscript{2}O\textsubscript{3} particles (Al\textsubscript{2}O\textsubscript{3}/Y\textsubscript{2}O\textsubscript{3}: 1.5). Two-dimensional Tyranno SA fibers were utilized as a reinforcing material for LPS-SiC\textsubscript{f}/SiC composite. A complex mixture with SiC, Al\textsubscript{2}O\textsubscript{3}, and Y\textsubscript{2}O\textsubscript{3} particles was impregnated into the fabric structure, using a gas pressure casting. The compact preform for the fabrication of LPS-SiC based materials was sintered at the temperature of 1820 °C. The characterization of all materials was investigated by means of SEM with EDS, XRD and three point bending test. Especially, The mechanical property of LPS-SiC materials were examined at the elevated temperatures of 1000 °C and 1200 °C in the argon atmosphere.

LPS-SiC materials represented a good density of about 3.1 Mg/m\textsuperscript{3}, accompanying the creation of secondary phases like YAG in the morphology. LPS-SiC materials showed an average flexural strength of about 750 MPa at the room temperature. The flexural strength of LPS-SiC materials greatly decreased with the increase of test temperature. LPS-SiC materials retained a poor strength of about 300 MPa at the temperature of 1200 °C. LPS-SiC\textsubscript{f}/SiC composites exhibited a density of about 2.7 Mg/m\textsuperscript{3}, due to some amount of matrix pores in the intra-fiber bundle microstructure. LPS-SiC\textsubscript{f}/SiC composites had an average flexural strength of about 300 MPa. Based on the mechanical property-microstructure correlation, process optimization methodology is also discussed.

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