

Low-Temperature Fabrication of Reaction Bonded Composites, Based on Sic and (Sic+B4C) Mixture, Infiltrated with Si-Al Alloy

Authors : Helen Dilman, Eyal Oz, Shmuel Hayun, Nahum Frage

Abstract : The conventional approach for manufacturing silicon carbide and boron carbide reaction bonded composites is based on infiltrating a ceramic porous preform with molten silicon. The relatively high melting temperature of the silicon infiltrating medium is a drawback of the process. The present contribution is concerned with an approach that allows obtaining reaction bonded composites by pressure-less infiltration at a significantly lower (850-1000oC) temperature range. This approach was applied for the fabrication of fully dense SiC/(Si-Al) and (SiC+B4C)/(Si-Al) composites. The key feature of the approach is based on using Si alloys with low melting temperature and the Mg-vapor atmosphere, under which an adequate wetting between ceramics and liquid alloys for the infiltration process is achieved. In the first set of the experiments ceramic performs compacted from multimodal SiC powders (with the green density of about 27 vol. %) without free carbon addition were infiltrated by Si-20%Al alloy at 950oC. In the second set, 19 vol. % of a fine boron carbide powder was added to SiC powders as a source of carbon. The green density of the SiC-B4C preforms was about 23-25 vol. %. In both cases, successful infiltration was achieved and the composites were fully dense. The density of the composites was about 3g/cm³. For the SiC based composites the hardness value was 750±150HV, Young modulus-280GPa and bending strength-240±30MPa. These values for (SiC-B4C)/(Si-Al) composites (1460±200HV, 317GPa and 360±20MPa) were significantly higher due to the formation of novel ceramics phases. Microstructural characteristics of the composites and their phase composition will be discussed.

Keywords : boron carbide, composites, infiltration, low temperatures, silicon carbide

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