Processing of Solid State Sintered α-SiC with Different Carbon-black Additions

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SiC has outstanding mechanical properties such as high strength, elastic modulus, hardness, and tribological properties [1]. Excellent creep resistance even at temperatures higher than 1500°C due to its highly covalent nature was also reported [2]. However, this covalent character makes SiC difficult to sinter. Therefore, sintering aids such as boron, aluminium, carbon, etc. are required for densification. Carbon is especially a critical additive to achieve as high densification as possible, since it removes the surface SiO_2 of the SiC powder during solid state sintering according to the equation [3];

$$SiO_2 + 3C \rightarrow SiC + 2CO \quad (1)$$

Particle size of the free carbon affects the removal of oxygen from the system and the final density of the sintered SiC. In this study, carbon-black powders with different particle sizes were added to the starting SiC composition in order to investigate their effects on densification and microstructural development. The batches were prepared according to wet processing routes in alcohol and aqueous mediums. Rotary evaporator and spray dryer were used for the granulation. Spark Plasma Sintering (SPS) and pressureless sintering techniques were performed to densify the compacts. The results revealed that the reduction in particle size of the carbon-black powder improved densification of the compacts during pressureless sintering. However, carbon particles in the slurry migrated to the surface of the granules during spray drying, leaving defects which reduces the achievable density of the compacts. On the other hand, it was observed that the defects were eliminated efficiently by SPS and consequently, high densification was achieved as independent from the particle size of the carbon-black powders.

Key words: SiC, carbon black, granulation, SPS, pressureless sintering

References

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