

Formation mechanism and elimination of mesophase in AlN powder synthesized in a carbothermal reduction nitriding process

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Abstract

A mesophase of Al₂OC was first determined in the AlN powder synthesized in batch quantities via a carbothermal reduction nitridation (CRN) process. The formation mechanism of the mesophase was described. Finally, the CRN process parameters were optimized to eliminate the mesophase in the AlN powder. The results show that as an incomplete reduction product of Al₂O₃, Al₂OC has a highly similar crystal structure to AlN. The formation of Al₂OC depends on the P_{N₂} and P_{CO} in the synthetic furnace. At the conditions of T = 1700 °C, P_{N₂} = 10⁻⁵ kPa, and P_{CO} = 10^{-0.008-10^{0.973}} kPa, the formation of Al₂OC is thermodynamically favorable. By increasing the flow rate of N₂ in the synthetic furnace, the formed Al₂OC was unstable and decomposed into AlN. Hence, the C and O contents of the AlN powder synthesized in batch quantities were greatly reduced. It can significantly improve the performance of the AlN ceramics.

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