Synthesis and Mechanical Properties of Ceramics Based on Si3N4 Fine Powder Derived by Diatomite Reduction

Irina Hussainova[1]

[1]Department of Materials Engineering, Tallinn University of Technology, Estonia

Abstract

Materials based on Si3N4 are potential high strength materials for structural applications at both high and ambient temperatures. The manufacturing of ceramic powders utilizes the carbothermal reduction of SiO2 in nitrogen atmosphere. In this work, diatomite was used as a source of silicon dioxide. Diatomite was mixed with carbon black and the final mixture was subjected to a heat treatment at nitrogen atmosphere. This procedure allowed obtaining predominantly hexagonal Si3N4 particles. Si3N4 powder compacts without additives may be fully densified by hot isostatic pressing. Residual impurity oxides (from dilatomite) like Al2O3, Fe2O3 and TiO2 may act as additives at sintering. It was shown that oxides affect a grain size and shape and promote formation of betta-Si3N4. Impurities were mostly the part of the intergranular microstructure that influence the mechanical properties of the ceramics to a great extend. The presence of residual impurities in a starting mixture depends strongly on conditions (temperature and time) of powder production. This study is concerned with the development of microstructure of Si3N4 ceramics and material's properties in dependence on the conditions of the process of powder manufacturing from diatomite.