DESCRIPTION FOR THE GENERAL PUBLIC

Fabrication of materials with designed properties is one of the most important and challenging approaches of nowadays materials engineering. The most promising way of obtaining products with desired properties is to prepare composite materials, consisting of at least two phases: matrix and dispersed phase. Connection of this two phases in one material improves some properties of the matrix. Mechanisms of this influence differ for various composites. Understanding of the mechanism working in a particular material is a crucial point when we want to achieve designed properties of the final product.

Silicon nitride is a widely use structural ceramic material. Outstanding mechanical properties and high temperature resistance are its most important features. Silicon nitride seems to be perfect matrix material for particulate reinforced ceramic composites. Incorporation of a dispersed phase will lead to eliminate some drawbacks of this material and maximize its advantages.

The aim of this research is to investigate the influence of some factors, like amount, kind and grain size of dispersed phase, on mechanical properties of silicon nitride based composites. Thermal stresses will be considered as a potential reason of changes in mechanical properties of silicon nitride based composites. Thermal stresses occurs during processing of ceramic composites with the mishmash of thermal expansion coefficient. When the composite is being cooled from sintering temperature to room temperature, below the temperature of stiffening phase components that shrink with different speed generate tensile and compressive stresses in material. The aim of this study is to prove that this residual stresses are the crucial factor influencing the mechanical properties of silicon nitride based composites and to achieve materials with increased fracture toughness and flexural strength.

In this study a few series of silicon nitride based composites will be prepared. In each series one parameter of phase components will be changed, for example grain size, volume fraction, kind of dispersed phase. Mechanical properties of all prepared composites will be measured. This procedure will lead to investigate the influence of each factor on mechanical properties of composites. Basing on microstructures of prepared materials, using Finite Element Method, thermal stresses will be simulated and thanks to that the influence of each factor on residual stresses of the composite will be checked. The real values of stresses will be determined by the analysis of the shape of X-ray diffraction pattern. The observation of crack propagation through the material will provide some interesting information about the mechanism of toughening in this composites. Taking all results together the effect of thermal stresses on mechanical properties of silicon nitride based composites will be characterized.

Understanding and checking the relationship between thermal stresses and mechanical properties of silicon nitride based composite will unable aware designing of this materials and thanks to that widen the potential application. This results will complement current information about the influence of thermal residual stresses on mechanical properties of silicon nitride based particulate composites.