

Title: Stabilities of Compounds and Reaction Mechanisms in the Ti-Si-O-N System

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Abstract:

Silicon nitride had been known as a chemical compound for a number of years. In 1960 the Admiralty Materials Laboratory, in the United Kingdom, developed methods for its fabrication into functional shapes. Since then a great deal of effort has been directed to the use of silicon nitride and related materials in diesel engines for pre-ignition chambers, pistons, combustion chamber liners, nozzle guide vanes, blades, heat exchangers and thermal and acoustic insulation. In spite of these successes, there have been problems in the fabrication of nitrogen ceramics because of the low sintering rates of covalently bonded materials.

An important development in the field of nitrogen ceramics was the finding that in the structure of silicon nitride, part of the silicon content could be replaced by aluminium and part of the nitrogen by oxygen. This gave rise to the sialons. The aim of the present research was to study the effect of titanium in the Si-O-N system, that is to examine the system Ti-Si-O-N. Attention was concentrated firstly on reaction mechanisms and the stability of the compounds formed. Techniques employed included X-ray diffraction, scanning electron microscopy, energy dispersive X-ray analysis and optical microscopy.

Thermodynamic calculations provided an analysis of the energy relations in the system. Particular attention was devoted to the effects of the gas phase. The results of the calculations provided further insight into reaction mechanisms.

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