

**EFFECT OF Si_3N_4 STARTING POWDERS FOR THE
DEVELOPEMENT OF SIALON CERAMICS FOR
TRIBOLOGICAL APPLICATIONS**

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Microstructure and final mechanical properties are quite important in the design of ceramic materials for different applications including wear applications. In this study, a series of fretting wear tests were carried out on a number of SiAlON ceramics, produced from different Si_3N_4 starting powders and densified using both pressureless and gas-pressure sintering routes. The effect of parameters such as the type, particle size, $\alpha:\beta$ phase ratio of starting Si_3N_4 powder, seed addition, post sintering heat treatment on the evolution of microstructure, mechanical and tribological properties were investigated. Correlation between fracture toughness, hardness, microstructure (e.g. grain size, $\alpha:\beta$ -SiAlON phase ratios; z values) and wear rate will be presented, and the possible wear mechanisms will be discussed.

MICROSTRUCTURAL CHARACTERISATION OF α - β SiAlONs

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SiAlON ceramics have a number of applications and are also candidate for many other applications due to their favourable mechanical and thermal properties. However, extensive applications of SiAlONs have not been realised due mainly to their higher cost compared to other readily available ceramics, which may not be ideal materials from properties point of view. More understanding is needed in order to improve properties, processing and chemistry in order to assist wider applications of SiAlONs.

Compared to Si_3N_4 , SiAlON ceramics have an added advantage in that there are more possibilities with respect to the design of intergranular phases, in particular its crystallinity. Crystallisation of the intergranular phase into more refractory form not only improves the high temperature properties, but also presents us an opportunity to use more intergranular phase without substantially degrading the required properties. This, in turn, provide an opportunity of processing coarser powder and/or sintering at lower temperatures and pressures. In addition, in α -SiAlON containing systems, excess liquid phase used during sintering and impurities present can be incorporated into α -SiAlON structure.

In this study, microstructures of α - β SiAlONs obtained by using different powders and dopants were characterised by various electron microscopy techniques. Particular attention is paid to the crystallinity of secondary phases and distribution of impurities. It was observed that crystallinity can be improved by dopant type. It was also found that Fe present as an impurity can be associated into SiAlON structure.

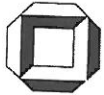
DEVELOPMENT STRATEGIES FOR SIALON CERAMICS

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SiAlON ceramics have a wide range of applications due to their favorable mechanical and thermal properties. They are one of the main groups of materials being considered for high temperature load bearing applications and room to moderate temperature applications involving mechanical and/or chemical processes. However, wide spread use of SiAlON ceramics has not been realized due to high cost of raw materials and of processing. In this study, improvements in materials properties and processing of SiAlON ceramics by compositional design will be given with various application examples.



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Certificate

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has already attended the 6th International Conference on Nitrides and Related Materials, 15 - 18 March 2009, Karlsruhe, Germany

Title of oral presentation:

EFFECT OF Si₃N₄ STARTING POWDERS FOR THE DEVELOPEMENT OF SiAlON CERAMICS FOR TRIBOLOGICAL APPLICATIONS

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ISNT 2009

**6th International Conference on
Nitrides and Related Materials**

March 15-18, 2009

Karlsruhe, GERMANY



**Organised by the
Institute for Ceramics in Mechanical Engineering
Karlsruhe University**

Ferhat KARAF

11:45 - 12:00 Kim D.K. RAMAN SPECTROSCOPY OF HIGH THERMAL CONDUCTIVITY AlN CERAMICS DOPED WITH CALCIUM FLUORIDE

12:00 - 13:15 LUNCH

TOPIC 5 MECHANICAL BEHAVIOUR

Chairman: Becher, P.

13:15 - 13:45 Wiederhorn S.-L. TENSILE VERSUS COMPRESSIVE CREEP OF SILICON NITRIDE

13:45 - 14:00 Schwind T. INFLUENCE OF HIGH TEMPERATURE AND WATER ON THE CYCLIC FATIGUE BEHAVIOUR OF SILICON NITRIDE

14:00 - 14:15 Fünfschilling S. DETERMINATION OF R-CURVES FROM CORRECTED LOAD-DISPLACEMENT DATA AND THE CALCULATION OF THE BRIDGING STRESSES FROM THESE R-CURVES

14:15 - 14:30 Härtelt M. PROBABILISTIC LIFETIME PREDICTION FOR CERAMIC COMPONENTS IN ROLLING APPLICATIONS UNDER CYCLIC LOADING

14:30 - 14:45 Schneider J. TRIBOLOGICAL PERFORMANCE OF TEXTURED SILICON NITRIDE MATERIALS UNDER DRY AND LUBRICATED OSCILLATING SLIDING CONDITIONS

14:45 - 15:00 ~~Calis Acikbas~~ N. EFFECT OF Si₃N₄ STARTING POWDERS FOR THE DEVELOPMENT OF SIALON CERAMICS FOR TRIBOLOGICAL APPLICATIONS

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|---------------|----------|----|---|
| 11:45 - 12:00 | Çalışkan | F. | EFFECT OF FLUORIDE AS A SINTERING ADDITIVE FOR SILICON NITRIDE BASED CERAMICS |
| 12:00 - 12:15 | Höhn | S. | MICROSTRUCTURE FORMATION IN α/β - SIALON-MATERIAL DURING SINTERING |
| 12:15 - 12:30 | Kara | F. | MICROSTRUCTURAL CHARACTERISATION OF α/β -SIALONS |
| 12:30 - 13:00 | Mandal | H. | DEVELOPMENT STRATEGIES FOR SIALON CERAMICS |

13:00 - 14:15 **LUNCH**

14:30 - 20:00 **POST CONFERENCE TOUR
MAULBRONN CISTERCIAN MONASTERY**

Guided tour to the monastery including a short organ recital. The visit will end at the "Klosterschmiede", with tasting of a choice of local wines.

Transport to Maulbronn and back to the conference hotel is organised by bus.
