

## **SOL-GEL PROCESSING FOR POROUS SILICA ANTIREFLECTIVE COATINGS**

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### **ABSTRACT**

An antireflective (AR) film produced by incorporation of polyethylene glycol (PEG) in the sol is compared to one produced using an "aged sol". Aging of the sol improved the AR properties only marginally, while incorporating organic polymer with the precursor solution is a more effective method of increasing the porosity of films and transmission of the glass substrate. It was also found that the films prepared from a sol containing a higher molecular weight polymer had more porosity and higher transmission. The higher molecular weight PEG has higher decomposition temperature and amount of polymer adsorbed per unit mass of adsorbent also increases with polymer molecular weight. Thus more PEG was trapped in the silicate matrix, increasing the porosity when the PEG decomposed. An attempt was made to combine the effects of aging and PEG addition but it was found that films became translucent after baking at the low PEG contents used. It is possible that the larger particle size of the aged sol enhanced phase separation due to the low compatibility between the PEG-silicate complex and solvent. The films prepared from unaged sols containing PEG were evaluated and passed the eraser test and the standard scotch tape test following each exposure to harsh conditions.

### **KEYWORDS**

Antireflective (AR) coating, sol-gel, refractive index, transmission, polyethylene glycol (PEG).

## **MECHANISM OF OXIDATION OF MAGNESIA-CARBON REFRACTORIES**

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### **ABSTRACT**

Effect of the amount of binder addition and the content of graphite on the decarburization of magnesia carbon refractories was studied.

Furthermore, the rate of the decarburization was studied kinetically in the temperature range 1273K to 1723K in air. The rate of the decarburization of the refractory added the large amount of binder was large and the growth of the thickness of decarburized layer was faster with decreasing the graphite content in the refractory. The effective diffusion coefficient of O<sub>2</sub> through the pores was proportional to the porosity in the decarburized layer. It appears that a decarburization process of a MgO-C refractory in air is mainly controlled by the diffusion of O<sub>2</sub> through the pores. The appropriate amount of binder addition and content of carbon may be an important developmental determinant in the choice of a MgO-C refractory for high quality steel production.

### **KEYWORDS**

Magnesia-carbon refractories, binder contents, carbon contents, porosity, oxidation kinetics, topochemical model, effective diffusion coefficients, activation energy.

## **STUDY ON SPONTANEOUS CRYSTALLINE-PHASE SEPARATIVE OPAQUE GLAZES FIRED FAST UNDER LOW TEMPERATURE**

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### **ABSTRACT**

Fast-fired fritted glazes in the KNaO-MgO-Al<sub>2</sub>O<sub>3</sub>-B<sub>2</sub>O<sub>3</sub>-SiO<sub>2</sub> system were investigated by means of SEM, EDX and XRD. Opacification of the glazes is attributed to the spontaneous bulk precipitation of enstatite crystals and successive phase-separation of glass matrix in glaze layers. B<sub>2</sub>O<sub>3</sub> acts as fusing agent, which favors both crystal growth and glaze fluidization during the firing cycle. A little Al<sub>2</sub>O<sub>3</sub> decreases high temperature viscosity of glaze melt and depresses the coarsening of crystallization, accordingly improving whiteness and gloss of glaze surface. By optimizing composition design and control of the firing process, we are able to obtain novel micro-crystalline or multiphase opaque glazes of good overall quality as well as rational cost performance.

### **KEYWORDS**

Spontaneous opaque glaze, crystalline-phase separative opaque glaze, single fast firing.

## **THE DIELECTRIC AND PIEZOELECTRIC PROPERTIES OF BTZ-SERIES CERAMICS WITH ADDITION OF GLASS FRIT**

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### **ABSTRACT**

Dielectric and piezoelectric properties of BaTiO<sub>3</sub> ceramic are significantly influenced by addition of 4PbO·B<sub>2</sub>O<sub>3</sub>. The melting temperature of the 4PbO·B<sub>2</sub>O<sub>3</sub> is around 500°C, so it would provide a liquid phase during the sintering process. Under low sintering temperatures, the grain growth of BaTiO<sub>3</sub> ceramics are enhanced by capillary action, rearrangement and solution-reprecipitation of the liquid phase. At high sintering temperatures, exaggerated grain growth of BaTiO<sub>3</sub> ceramic is restrained by the presence of a liquid phase. The spreading liquid can penetrate the solid-solid interfaces. Penetration leads to disintegration of the solid and subsequent rearrangement of fragments. With suitable amounts of glass frit and an optimized sintering temperature, the density is enhanced and the values of the dielectric and piezoelectric properties are improved.

### **KEYWORDS**

Dielectric and piezoelectric properties, grain growth, barium titanate.

## **THE EFFECTS OF SOLID LUBRICANT VARIETIES ON THE PROPERTIES OF SELF-LUBRICATING $\text{Al}_2\text{O}_3$ -BASED CERAMIC COMPOSITE MATERIALS**

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### **ABSTRACT**

Two types of self-lubricating ceramic composite materials have been synthesized via hot pressed sintering and the tribological characteristics are performed using a pin-on-disc device. X-ray diffraction (XRD) and scanning electron microscopy (SEM) are used to characterize the phase composition and microstructure. The obvious differences of self-lubricating and mechanical behavior are observed between graphite/alumina and boron nitride/alumina samples. The influence of solid lubricant varieties on the properties of the materials has been discussed in this paper. The main reasons, caused this difference of properties, are attributed to the disparity on the chemical compatibilities and physical matches between the two lubricants and matrix.

### **KEYWORDS**

Self-lubrication, multiphase ceramic, solid lubricant, chemical compatibilities, physical matches, friction and wear, graphite, boron nitride.

## **IMPROVEMENT OF THERMOELECTRIC PROPERTIES OF FeSi<sub>2</sub> BY ADDING OXIDES AND THEIR INTERFACES**

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### **ABSTRACT**

The purpose of the present study is to improve the efficiency of the thermoelectric material iron disilicide, FeSi<sub>2</sub>. The fabrication of this material involves a few phase transitions which include an annealing process in order to obtain  $\beta$ -FeSi<sub>2</sub> employed for the thermoelectric material. Before annealing, the phases of the material are mostly  $\alpha$ - and  $\epsilon$ -phase. To get the  $\beta$ -FeSi<sub>2</sub> phase completely, annealing for 24 to 48 hours is usually necessary. We have added the transition metal oxides and lanthanum oxides to FeSi<sub>2</sub>, to reduce thermal conductivity and to lower the electrical resistivity. Yb<sub>2</sub>O<sub>3</sub> addition to  $\beta$ -FeSi<sub>2</sub> provided the highest efficiency relative to Cr-, Ti-, Ni-oxides and La-oxides. The interface between FeSi<sub>2</sub> and the oxide is suggested to play a role to decrease annealing time to form the  $\beta$  phase and reduce the thermal conductivity.

### **KEYWORDS**

Iron disilicide, thermoelectric properties, phase transition of FeSi<sub>2</sub>, annealing time, thermal conductivity, Seebeck coefficient, interface.

## **MICROWAVE SINTERING OF YTTRIA-ZIRCONIA CERAMICS**

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### **ABSTRACT**

2, 3, 4, 5, 6, 7, 8mol% Yttria-Zirconia ceramics were studied. The densification, microstructure, phase and mechanics properties were examined and compared with those of conventionally sintered samples. It was found that microwave sintering enhanced densification under some conditions. It was also shown that a soaking time of only 10 min is enough to sinter those samples by microwave heating. The mechanical property is different between microwave and conventionally sintered samples. Some microwave-sintered samples have higher bending strengths than those obtained by conventional sintering. The tetragonal phase was improved by microwave sintering, and the critical grain sizes of microwave sintered 2 and 3 mol% Yttria-Zirconia samples were larger than normal critical grain size.

### **KEYWORDS**

Microwave sintering, Zirconia-Yttria, flexural strength, tetragonal, stabilizer.

## **HYDROTHERMAL REACTIONS IN INORGANIC MATERIALS SCIENCE**

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### **ABSTRACT**

This is a review and an overview paper related to hydrothermal relations in inorganic materials synthesis. The paper includes hydrothermal reaction sintering, hydrothermal powder preparation, hydrothermal corrosion, hydrothermal crystal growth, characteristics of hydrothermal powders etc.

### **KEYWORDS**

Hydrothermal, powders, sintering, corrosion.