Metallizing of Silicon Nitride Ceramics

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It was found that a metallized layer can be formed on Si_3N_4 ceramics using the paste containing Li_2MoO_4 and TiO_2. X-ray diffraction pattern and SEM observations revealed that the metallized layer consisted of Mo, TiN, $Y_2O_3 \cdot 2SiO_2$, etc., and that the thickness was around 7 μm. Metallized Si_3N_4 specimens were bonded to steel by Ag-Cu solder after Ni plating. The shear strength of the bonded specimens was about 130 MPa at room temperature, 100 MPa at 300°C and 50 MPa at 500°C. [Received August 8, 1985]

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Oxidation Resistance of AlN Coated Graphite Prepared by Plasma Enhanced CVD

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Uniform and adherent aluminum nitride (AlN) films were coated on graphite substrate by plasma enhanced chemical vapor deposition using a reaction gas mixture of $AlBr_3$, N_2, H_2 and Ar. The oxidation resistance test of AlN coated graphite specimen (15×10×1 mm) was carried out in air (relative humidity : ~50%) in the temperature range from room temperature to 1200°C. Thermogravimetric analysis of the specimen showed that the oxidation resistance depends upon the preferred orientation and the film thickness of the AlN film. No oxidation of the graphite substrate occurred even at 1200°C, when the specimen was coated uniformly by the thick AlN film (thickness>15 μm) with a high preferred orientation to the *c* axis. At elevated temperatures (1050°-1200°C), these films followed the parabolic oxidation law. The oxidized surface layer of α-Al_2O_3 was confirmed to act as a passivation film for further oxidation of AlN film. However, the AlN films having low preferred orientation, were oxidized at 1200°C approximately linearly with the oxidation time. The latter film was unfavorable for the oxidation-resistant film of graphite. [Received July 30, 1985]

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Thermal Shock Testing of Dense SiC by Water-Quenching

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For the evaluation of thermal shock resistance of ceramics, water quench test in which a critical temperature difference, ΔT_c, is measured by degradation of strength has often been applied, although

many experimental conditions may influence the result. The main reason for using this method is that the test can be easily carried out. In this report, the effect of variation of heat transfer coefficient on the result was analyzed. Reaction-sintered (RB-) and pressureless-sintered (S-) SiC were used. A semicircular crack was introduced by Knoop hardness indentation on a polished surface of the specimen of 5×36×(2-5)mm. Each specimen was quenched in a 50 cm-deep water bath kept at 290±2 K and then its bending strength was measured in 4-point bending. The value of ΔT_c was determined from a diagram of bending strength and quench temperature difference. Generally RB-SiC showed larger resistance than S-SiC, mainly because of much higher thermal conductivity of RB-SiC. Thermal stress generated by quenching at the indentation site and the surface heat transfer coefficient h was calculated from the following relation,

$$\sigma=\frac{E\alpha\Delta T}{1-\nu}f(\beta)$$

where σ is the stress generated, α the thermal expansion coefficient, E Young's modulus, ΔT the temperature change, ν Poisson's ratio and $\beta(=ah/k)$ is Biot's modulus, with k the material's thermal conductivity and a the characteristric length. Contrary to the above, the thermal stress generated was calculated as a function of quench temperature difference using the h value. Consequently Knoop indented specimen gives more than two ΔT_c's in some case and no well defined ΔT_c in other case.

[Received July 26, 1985]

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Thermal Expansion of Chemically Vapor-Deposited Si_3N_4

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The thermal expansion of chemically vapor-deposited (CVD) Si_3N_4 was investigated from 20° to 1000°C. X-ray and TEM analyses revealed that CVD-Si_3N_4 samples prepared from a mixture of $SiCl_4$, NH_3 and H_2 were only α-Si_3N_4 and free from impurity phases even at grain boundaries. The thermal expansion was measured using dilatometry, and X-ray diffraction techniques. The bulk CVD-Si_3N_4 specimens with (110) and (210) orientations indicated a lower coefficient of thermal expansion than those for the specimens with (222) orientation. This difference in thermal expansion may be the effect of the crystallographic anisotropy. In fact, X-ray diffraction technique revealed that the coefficient of thermal expansion of α-Si_3N_4 is lower in the a axis than in the c axis.

[Received August 12, 1985]

pp. 146–8

Thermal Conductivity of Pressureless-Sintered SiC with B_4C and C

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The effects of amount of additives B_4C and C on the thermal conductivity and bulk density, and the relation between the thermal conductivity and bulk density were described. SiC con-