

INFLUENCE OF STRESS ON OXIDATION OF HOT ISOSTATICALLY PRESSED SILICON NITRIDE

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Ceramics have been used in high temperature structural applications because of their high strength at elevated temperatures, low coefficient of thermal expansion and high oxidation resistance. Materials based on Silicon Nitride (Si_3N_4) are potential candidates in high temperature applications due to their excellent high temperature properties. Particularly, Si_3N_4 with Yttria (Y_2O_3) as a hot pressing additive has shown improved properties due to one or more highly refractory grain boundary phases present in the material.

In the present work influence of stress on oxidation of Hot Isostatically Pressed (HIPed) Si_3N_4 with 4wt% Y_2O_3 has been studied. Samples were stressed in four point bending mode. Microstructural analysis was carried out using X-Ray Diffraction(XRD), Transmission Electron Microscopy(TEM) and Scanning Electron Microscopy(SEM).

SEM, TEM and XRD studies on as-received material revealed that HIPed Si_3N_4 contained both α - and β - Si_3N_4 , α -yttrium disilicate (α - $\text{Y}_2\text{Si}_2\text{O}_7$) and a very thin intergranular films of residual glass. The material exhibited good oxidation resistance at temperatures up to 1400°C. The oxide scale of the unstressed material contained a considerable amount of α - $\text{Y}_2\text{Si}_2\text{O}_7$ crystals having irregular and elongated shapes. Formation of $\text{Y}_2\text{Si}_2\text{O}_7$ was probably due to the outward diffusion of Y^{3+} from the intergranular glass phase within the material. The oxide layer on stressed regions was different from that on the load free part of the sample. SEM studies on stressed samples showed that there were more elongated $\text{Y}_2\text{Si}_2\text{O}_7$ crystals on the compressive side.