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Part I
ABSTRACTS

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ET-11 Microstructural changes during deformation of hot isostatically pressed silicon nitride with 4 wt% yttria

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The combination of high strength, wear resistance, high decomposition temperature, oxidation resistance and resistance to corrosive environments makes silicon nitride (Si_3N_4) a promising material for high temperature structural applications. The properties of Si_3N_4 ceramics are strongly influenced by the properties of the secondary phases present in the material. One limitation to the use of structural ceramics at high temperature is the tendency of these materials to creep and to fail by creep rupture. Changes in microstructure during creep has significant influence on the deformation process.

In order to understand the microstructural changes during high temperature (1200 - 1450°C) deformation of Hot isostatically pressed (HIPed) Si_3N_4 with 4 wt% yttria, creep tests were carried out using a creep testing apparatus designed

in this laboratory and the microstructural studies were carried out using X-ray diffractometry (XRD) and Electron microscopy.

The electron microscopy and XRD studies showed that the microstructure of this material consisted of a major crystalline phase Si_3N_4, a secondary crystalline phase á-$Y_2Si_2O_7$ and a small amount of intergranular glassy phase.

The major microstructural change during high temperature deformation was the formation of two types of cavities, multi-grain junction cavities and lens-shaped cavities. The multi-grain junction cavities were mainly observed in the compressive side while the lens-shaped cavities were observed in the tensile side of the sample. Grain boundary sliding, as a result of shear stresses acting on the grains, is responsible for the formation and development of multi-grain junction cavities. Whereas, the tensile stresses acting perpendicular to the grain boundaries are responsible for the formation of lens-shaped cavities.

The lens-shaped cavities were typical of diffusion controlled cavitation observed in metals. The cavity growth is likely to occur by diffusion of vacancies along the surface of cavities and /or along the amorphous grain boundaries present in the material. Redistribution of the second phase was also identified in the deformed samples.