EFFECT OF Y_2O_3 ADDITION ON HIGH TEMPERATURE CREEP PROPERTIES OF Si_3N_4 CERAMICS

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Silicon Nitride (Si_3N_4) is one of the most promising material for high temperature applications due to it's outstanding physical properties at high temperatures. Si_3N_4 is a covalently bond solid and hence the self diffusivity is low for solid state sintering. Therefore sintering additives are required to densify the material, which provide a liquid phase for sintering. An important requirement of the oxide additive is that they are highly refractory and form refractory secondary crystalline phases. Y_2O_3 fulfilled this requirement and in the present work it has been used as the sintering aid.

Most high temperature materials fail by creep and creep rupture at elevated temperatures and therefore, the creep properties are important. In this study, high temperature creep behaviour of Hot Isostatically Pressed (HIPed) Si_3N_4 containing 3.5, 4 and 7.5 wt% Y_2O_3 was investigated in an ambient air atmosphere in four point bending mode. The materials selected in this study were in the Si_3N_4 - Si_2N_2O - $Y_2Si_2O_7$ compatibility triangle of the Si-Y-O-N system in order to minimize the oxidation. Material with 7.5 wt% Y_2O_3 which was used in this work was a tailored one to lie within the above triangle by addition of 2.5 wt% SiO_2.

All the materials investigated in this study demonstrated excellent resistant to creep at these temperatures. Material with 4wt% Y_2O_3 showed the lowest strain rate at these temperatures. Investigations revealed that the stress exponent n for creep deformation of 7.5wt% material was $\approx$ 1. The other two materials exhibited non-linear dependence of creep rate on stress.

Microstructural investigations revealed that the material containing 4wt% Y_2O_3 cavitated during the creep deformation. A detailed microstructural study on the other materials will contribute to an understanding of the exact deformation process.

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