ABSTRACT

The broad aim of this research programme was to understand the high temperature creep behaviour and microstructures of two glass ceramic composite systems.

The major difference between the two types of glass ceramic composites are the matrix compositions and the fibre orientation in the matrix. Lithium Aluminosilicate (Li_2O - Al_2O_3 - $4SiO_2$) glass ceramic (LAS) is uni-axially reinforced and Calcium Aluminosilicate (CaO - Al_2O_3 - SiO_2) glass ceramic (CAS) is bi-axially reinforced with SiC (Nicalon) fibre.

Creep tests were carried out under an ambient air atmosphere in four point bending configuration. All the creep tests were performed in the temperature range 950 - 1200^{o}C and in the stress range 70 - 250 MPa.

Scanning Electron Microscopy (SEM) studies of as received samples were conducted and it was observed that the fibre volume percentage was about 30% in both composite materials. Average diameter of a fibre was about 10 μm and grain size of the matrix was very small (less than 1 μm).

In addition to the microstructure, the crystallization behaviour of LAS glass ceramic was studied indirectly by measuring the a.c. impedance of the material. A sharp variation of the resistivity is observed at 625^{o}C. This temperature is expected to be the glass-transition temperature of the material.

Observed stress exponent values are close to one for both materials and the activation energy for the creep deformation is around 250 KJ mol^{-1}. This indicates that a diffusion assisted mechanism is responsible for the creep deformation of both composite materials.

A clear increase of the activation energy is observed in heat treated composite samples. This could be due to the change of phases in the interface resulting in a change of the interfacial sliding resistance during the heat treatment.

Acoustic emission signals of microcracks during a bending test of the composite materials were obtained. These results give us information about toughening mechanisms of the composite material and the change of mechanical properties of the fibre-matrix interface due to the heat-treatment.