PLAN OF THE WORK

Present investigation was undertaken to develop a precursor powder in alumina mullite composite through semicolloidal route in aqueous phase. The mixing was carried by dispersing ingredients, i.e. the finely milled dehydroxylated china clay in an aqueous salt solution of Al(NO₃)₂ followed by hydrolysis and gel formation for the proper distribution of solid particles in the gel matrix.

For this purpose Rajmahal china clay, one of the good varieties of kaolinitic type of clay available in India was selected. It was purified from the associated impurities and subjected to dehydroxylation within the temperature region 600–650°C for a fixed soaking period. The dehydroxylated clay in the form of fine powder was dispersed in Al(NO₃)₃ solution. The mole ratio of SiO₂:Al₂O₃ was adjusted to 1:1.5, 1:1.75 and 1:2 respectively. Formation of Al(OH)₃ coating on the dehydroxylated clay particles was achieved with the controlled addition of ammonia at a particular pH for completion of the hydrolysis reaction. The set gel was thoroughly processed to remove the adherent impurities. This was dried at low temperature in order to minimise particle agglomeration. The dried mass was further milled to fine state of subdivision.

The physico chemical characteristics of the precursor powder, e.g. chemical analysis, loose bulk density, surface area, particle size distribution, thermal and X-ray diffraction analysis have been examined. Infra red analysis of the precursor powders prepared at different mole ratios of SiO₂:Al₂O₃ was performed to get insight into the nature of vibration relating to different bonds in the system.

All the hydrogels have been subjected to equilibrium dehydration at different temperatures, which involves loss of water from the hydrogel
structure. The hydrogel has indicated reversible dehydration-rehydration behaviour over a certain range of temperature and as such dehydrated sample at each temperature was subjected to rehydration at four different humidities such as 35, 55, 75 and 100% RH.

Water is an essential constituent in the hydrogel structure and in order to throw some light into the mechanism of the dehydration process kinetics of the thermal dehydration process was performed in the temperature zone as ascertained from the DTA endothermic peak.

In the final part of the present investigation the precursor powder was compacted in the form of discs and bars by uniaxial pressing. Before fabrication the precursor powder was calcined to remove the gel water, which might cause excessive shrinkage and inhomogeneity. Certain portion of the uncalcined material was used as green bond. The fabricated shapes were thoroughly dried and then subjected to reaction sintering in a slightly oxidising atmosphere at temperatures ranging from 1400 to 1600°C respectively for a fixed soaking period of two hours. The doping agent, i.e. TiO₂ was mixed with the precursor powder first in the solid state followed by dispersion in acetone medium and subsequent evaporation of the solvent. The magnitude of sintering was examined by measurement of certain properties such as volume shrinkage apparent porosity, bulk and true densities, flexural strength, thermal shock resistance.

The developed crystalline phases were identified through x-ray diffraction analysis.

All the important properties of this type of composite depend on the nature of the microstructure developed after sintering, i.e. the distribution of the different phases. Thus the nature of the phase assemblage was studied through scanning electron microscopy.