Porous and Dense Cordierite Ceramic from Raw Illite Clay

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Ternary system $MgO-Al_2O_3-SiO_2$ contains many technically valuable crystalline phases such as enstatite, forsterite, spinel and cordierite. For most of these phases coefficient of thermal expansion (CTE) is extremely low (as low as $1.5 \cdot 10^{-6}$ K^{-1}) which allows for them to be used in conjunction with other thermally demanding materials like quartz, for example. Also, other important properties like their high mechanical strength and good dielectric permeability is of value for potential use in practical applications. Cordierite ceramic materials, for example, are good candidates for both electronic circuitry substrates, when prepared as dense material and for use in filtration systems, when prepared as porous material.

Formation of cordierite from oxide powders takes place above 1350 °C. Rational preparation of such material requires modifications in synthesis rout, i.e., addition of flux forming agents or presence of volatile compounds. In this work the use of Latvian illite clay as partial raw material for preparation of both dense and porous cordierite ceramics was studied. No additional artificial flux and/or volatiles were used. Obtained dense ceramic samples were tested for their mechanical strength, and porous samples – for their pore morphology and porosity. It was determined that the use of illite clay of no less than 1/3 of total mass was enough to form both extremely dense and tough (compressive strength of about 400 MPa) and extremely porous (about 96% apparent porosity) materials by just adjusting thermal treatment regime. The X-Ray diffraction of the samples showed that formation of single-phase crystalline cordierite can also be achieved in relatively lower temperatures, e.g., as low as 1300 °C.

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