Thermal Conductivity of SiC-BeO Ceramic

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The temperature dependence of the thermal conductivity of SiC ceramic with up to 3% of BeO for various porosities (P = 7.5, 12.5, 13.3, 21.3%) is investigated. For evaluation of the temperature and concentration dependence of thermal conductivity (λ), the thermal expansion coefficient (α), specific heat C_p, and the longitudinal and transverse sound velocity were measured. It was determined, that the dependence of the effective thermal conductivity on porosity (P) is described by the expressions:

$$\lambda = \lambda_0 (1 - BP) \tag{1}$$

$$\lambda = \lambda_0 \exp(-\beta P) \tag{2}$$

where for compositions of SiC-BeO B = 2.6 , β = 4.2 and λ_0 is the thermal conductivity at P = O. The deviation of the experimental data for λ from the calculated values using expressions (1) and (2) are less then 6%. The effective thermal conductivity of all investigated structures decrease as $\lambda \sim T^{-n}$ (n = 0.92 - 0.88). The thermal conductivity of SiC-BeO ceramics increases with increasing BeO and is higher than for pure SiC. The connection between thermal and mechanical properties and temperature and porosity is observed. The maximum of λ at the concentration 1.3-1.4 at.% of BeO is observed. In this interval of concentration the maximum of sound velocity, Young modulus , increasing of resistivity and minimum of (α) are observed. This is explained by gradual filling of vacancies by beryllium during hot pressing, and filling of intercrystalline space by beryllium oxide. This leads to reduction of phonon scattering on vacancies and grain boundaries of SiC. It was determined that at a content of 1.2-1.5 at.% of BeO in SiC, ordered series of solid solutions are formed.