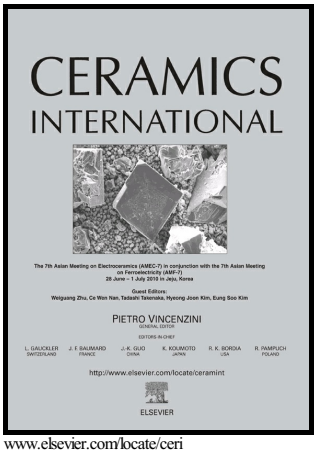

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Self-healing of Al_2O_3 containing Ti microparticles

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Abstract

This work explores the possibility of using embedded micron-sized Ti particles to heal surface cracks in alumina and to unravel the evolution of the crack filling process in case of pure solid-state oxidation reactions. The oxidation kinetics of the Ti particles is studied and the results are applied in a simple model for crack-gap filling. An activation energy of 136 kJ/mol is determined for the oxidation of the Ti particles having an average particle size of 10 μm. The almost fully dense alumina composite containing 10 vol. % Ti has an indentation fracture resistance of 4.5 ± 0.5 MPa $m^{1/2}$. Crack healing in air is studied at 700, 800 and 900 °C for 0.5, 1, and 4 h and the strength recovered is measured by 4-point bending. The optimum healing condition for full strength recovery is 800 °C for 1 h or 900 °C for 15 min. Crack filling is observed to proceed in three steps i.e., local bonding at the site of an intersected Ti particle, lateral spreading of the oxide and global filling of the crack. It is discovered that, although significant strength

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