
ABSTRACT

Silicon carbide ceramics have many attractive properties, one of which is their high degree of corrosion resistance. Even though corrosion is slow, it does occur. Standard procedures for corrosion testing such as the immersion method is limited due to the low corrosion rates of most of these materials: it does not elucidate the mechanism of corrosion, but only gives the rate and degree of dissolution. Electrochemical techniques offer the possibility to further elucidate corrosion mechanisms and establish the resistance stability of conducting or partially-conducting ceramic materials, thus enhancing the understanding of ceramic material behaviour. In conjunction with microstructural changes, the electrochemical corrosion behaviour of solid state sintered silicon carbide (SSiC) and liquid phase sintered silicon carbide (LPSSiC) have successfully been studied at room temperature in acidic and alkaline environments by using potentiodynamic polarisation measurements. Several hypotheses were proposed to assist in establishing the effect of silicon and carbon on the corrosion mechanisms of these materials. The effect of the secondary phase on the electrochemical corrosion of the LPSSiC was also investigated. Corrosion current densities of the LPSSiC materials were much lower than the SSiC materials in all test solutions. The SSiC materials showed pseudo-passive behaviour in HCl and HNO₃, due to the formation of thin layer of SiO₂ on the surface. The carbon in the SiC compound increased the corrosion current densities in all test solutions for SSiC materials. The electrochemical corrosion of LPSSiC is due to the dissolution of SiC and not the oxides; the chemical attack on the oxide phases is mainly by acid-base type of reactions, rather than electrochemical corrosion involving redox reactions.
