EFFECTS OF MILLING ENERGY ON SILICON CARBIDE PARTICLES

John Wanjala, Andras Sápi, Imre Szenti, Tamás Boldizsár, Koszma Gábor, Zita Sándor

Doctoral School of Environmental Sciences, Department of Applied and Environmental Chemistry, University of Szeged, H-6720 Szeged, Rerrich Tér 1, Hungary.
Email: namumawanjala@gmail.com

Abstract

Technical ceramics have properties that aid environmental pollution management products. Their ability to withstand high operation temperatures above 1000 ^{O}C make them suitable for applications in solar energy conversion, catalyst support, photovoltaic as well as power plant engine systems. In addition to this, ceramic materials have high resistance to thermal shock, wear and corrosive attack. As a result, ceramics are the best placed materials to use in water processing and treatment environmental technologies.

Research to improve thermo-mechanical properties of ceramics has gained momentum. Nanoparticles have been attractive in the field of material properties optimization due to their unique properties to impart '1 + 1>2' effect. Among them SiC nanoparticles are attracting global attention due to their excellent thermo-mechanical properties. However, agglomeration of SiC nanoparticles is a major setback in their ceramic applications. In this study the effects of energy on particle agglomeration in planetary milling have been investigated. SiC particles of the size range (0.2-1.8) mm were milled in a planetary mill between (100-600) rpm with varying time intervals (1-6) hours. Ball to Powder Weight Ratio and vial volume occupancy ratio were varied during sample milling. Samples were analysed using XRD, SEM-EDX and DLS.

SEM and XRD result of the fresh SiC showed that SiC particles were mostly angular shaped and of β-SiC/ 3C-SiC polytype. XRD analysis showed that crystallinity reduced from 76.65% to 20.49 % and crystallite size reduced from 52.96 nm to 5.93 nm, while the lattice strain increased from 1.7692 to 5.1493. In the sample milled at 600 rpm for 6 hours, the lattice strength dropped to 1.6902 due to highly amorphous nature (79.51%) of the sample. SEM analysis showed that milled samples were irregular and the surface morphology was rough. The Hydrodynamic diameter reduced from approximately 390 nm in samples milled at 100 rpm to 280 nm in samples milled at 600 rpm for 6 hours. The dispersity index showed that the particles were mainly polydisperse. This was attributed to the agglomeration/ aggregation of SiC particles during milling process.

Key words: *XRD, SEM-EDX, DLS, Silicon Carbide, Thermo-Mechanical Properties, Hydrodynamic Diameter and Dispersity.*