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The Effects of MWCNT Addition to Physical Properties of ZTA-MgO Cutting Tool
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Abstract
The purpose of this study is to develop ZTA-MgO-MWCNT cutting insert with enhanced properties and excellent tool performance that is suitable for high-speed machining. The effects of MWCNT addition on the physical properties of ZTA-MgO composites were investigated. The samples were fabricated using 80:20 composition (80 wt.% of Al2O3: 20 wt.% of YSZ) with fixed amount of MgO at 1.1 wt.% and MWCNT ranging from (0.1 – 0.5 wt.%) as secondary additives. The CNT was pre-treated in ethanol for 1 hour using an ultrasonic homogenizer before mixing and ball milled with Al2O3, YSZ and MgO compositions for 24 hours. The mixture is then pressed at 100 MPa into round-shaped cutting inserts mold after being dried at 100°C for 24 hours. The pressed samples were sintered at 1600 ºC for 4 hour soaking time. XRD, density, porosity and shrinkage analysis performed on the samples. The XRD analyses indicate the presence of major phases were α-Al2O3, ZrO2, Zr0.963Y0.037O1.982 and MgAl2O4. The effect of MWNT addition on density, porosity and shrinkage of ZTA-MgO shows that density (4.210 g/cm3) and percentage of shrinkage (8.05%) obtained the highest value by 0.2 wt.% MWCNT compared with samples without CNT additives which is only 4.020 g/cm3 and 7.05% respectively. High density value indicates that the shrinkage percentage is also high, which corresponds to the densification of the composites. Poor dispersion of MWCNT within the matrix is highly accounted for agglomeration around Al2O3 grain boundaries and decreases in densification.

Author Keywords
ceramic tool; CNT; nano; toughening; ZTA

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