The effects of CeO$_2$ addition on the physical and microstructural properties of ZTA-TiO$_2$ ceramics composite

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Abstract
The effect of CeO$_2$ addition ranging from 0 wt. % to 7 wt. % on phase, microstructural evolution, physical and mechanical properties of ZTA-3 wt. % TiO$_2$ ceramic composite were investigated. The samples were prepared by solid state mixing and sintered at 1600 degrees C for 1hr under pressureless condition. Samples were then characterized by XRD, SEM, densitometer and Vickers indentation method. Based on XRD analysis, m-ZrO$_2$ began to diminish at 1 wt. % CeO$_2$ while secondary phases, i.e. CeO$_2$.75ZrO$_2$ and ZrO$_2$.4TiO$_2$ began to diminish at 3 wt. % CeO$_2$ addition. SEM images showed finer grain sizes was produced upon increasing amount of CeO$_2$ up to 5 wt. %, corresponding to higher average grain intercept (AGI) values. From the results obtained, the optimum amount of CeO$_2$ addition was at 5 wt. % which yielded the highest bulk density (4.41 g/cm$^3$), firing shrinkage (21.94%), hardness (1580.10HV) and fracture toughness (9.77 MPa m$^{1/2}$). This is contributed by the grain refinement and the highest amount of secondary phases formed, especially ZrO$_2$.4TiO$_2$. However, with an excessive addition of CeO$_2$, i.e. more than 5 wt. %, grain sizes enlarged and the amount of secondary phases reduced, which degraded the mechanical properties of ZTA-3 wt. % TiO$_2$. (C) 2018 Elsevier B.V. All rights reserved.

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