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The effects of CeO₂ addition on the physical and microstructural properties of ZTA-TiO₂ ceramics composite

by: [Azhar, AZA \(Azhar, Azzahra Zahirani Ahmad\)^{\[1\]}](#); [Shawal, SHM \(Shawal, Siti Hajar Mohamad\)^{\[1\]}](#); [Manshor, H \(Manshor, Hanisah\)^{\[2\]}](#); [Ali, AM \(Ali, Afifah Mohd\)^{\[1\]}](#); [Rejab, NA \(Rejab, Nik Akmar\)^{\[3\]}](#); [Abdullah, EC \(Abdullah, Ezzat Chan\)^{\[4\]}](#); [Ahmad, ZA \(Ahmad, Zainal Arifin\)^{\[3\]}](#)

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Abstract

The effect of CeO₂ addition ranging from 0 wt. % to 7 wt. % on phase, microstructural evolution, physical and mechanical properties of ZTA-3 wt. % TiO₂ 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-ZrO₂ began to diminish at 1 wt.% CeO₂ while secondary phases, i.e. Ce_{0.7}Zr_{0.3}O₂ and Zr_{0.4}Ti_{0.6}O₂ initiated at 3 wt.% CeO₂ addition. SEM images showed finer grain sizes was produced upon increasing amount of CeO₂ up to 5 wt.%, corresponding to higher average grain intercept (AGI) values. From the results obtained, the optimum amount of CeO₂ addition was at 5 wt. % which yielded the highest bulk density (4.41 g/cm³), 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 Zr_{0.4}Ti_{0.6}O₂. However, with an excessive addition of CeO₂, 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. % TiO₂. (C) 2018 Elsevier B.V. All rights reserved.

Keywords

Author Keywords: ZTA-TiO₂ ceramic composite; CeO₂; Fracture toughness; Vickers hardness; Microstructure

KeyWords Plus: ZIRCONIA-TOUGHENED ALUMINA; MECHANICAL-PROPERTIES; SOLID-SOLUTIONS; FRACTURE-TOUGHNESS; SYSTEM ZR_{0.2}-TiO₂; CERIA; PHASE; WEAR; CE₁-XZR_XO₂-DELTA; NANOCOMPOSITE

Author Information

Reprint Address: Manshor, H (reprint author)

Int Islamic Univ Malaysia, Fac Engr, Dept Sci Engr, POB 10, Kuala Lumpur 50728, Malaysia.

Organization-Enhanced Name(s)

International Islamic University Malaysia

Addresses:

[1] Int Islamic Univ Malaysia, Dept Mat & Mfg, Fac Engr, POB 10, Kuala Lumpur 50728, Malaysia

Organization-Enhanced Name(s)

International Islamic University Malaysia

[2] Int Islamic Univ Malaysia, Fac Engr, Dept Sci Engr, POB 10, Kuala Lumpur 50728, Malaysia

Organization-Enhanced Name(s)

International Islamic University Malaysia

[3] Univ Sains Malaysia, Struct Mat Niche Area, Sch Mat & Mineral Resources Engr, Engr Campus, Nibong Tebal 14300, Penang, Malaysia

[4] Univ Teknol Malaysia Kuala Lumpur, MJIT, Kuala Lumpur 54100, Malaysia

E-mail Addresses: hanisahmanshor@iiu.edu.my

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