Microwave sintering of zirconia-toughened alumina (ZTA)-TiO2-Cr2O3 ceramic composite: The effects on microstructure and properties

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Abstract

This paper focuses on the development of a zirconia-toughened alumina ZTA-TiO2-Cr2O3 ceramic composite by means of microwave sintering at 2.45 GHz within the range 1200 degrees C-1400 degrees C, with a dwell time of 5-20 min. It is aimed at attaining improved microstructure and properties at a lower sintering temperature and shorter soaking time, compared to using a conventional heating method. Consequently, the effects of sintering temperature and soaking time on densification, properties and microstructural behaviour of the composite, are investigated. XRD analysis reveals that the microwave-sintered samples possess a higher crystallinity at a higher sintering temperature. Microstructural analysis confirms the uniform distribution of particles and controlled grain growth; with the lowest AGI value being 1.28 grains/mm. The sample that is microwave-sintered at 1350 degrees C with 10 min of soaking time achieves a high density (95.74% of the theoretical density), elevated hardness (1803.4 HV), and excellent fracture toughness (9.61 MPa m(1/2)), and intergranular cracks. This proves that the microwave sintering technique enhances densification, microstructural evolution and the properties of the ceramic composite at a lower temperature and shorter soaking time, compared to conventional heating. Overall, the improved mechanical properties of the microwave-sintered ceramics, compared to conventionally-sintered ceramics, are attributed to the enhanced densification and finer and more homogeneous microstructure that is achieved through the use of a microwave sintering method. The results reveal that microwave sintering is effective in improving the microstructure and density of materials, and will be useful for enhancing the mechanical properties of ZTA-TiO2-Cr2O3 ceramic composites. (C) 2017 Elsevier B.V. All rights reserved.

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