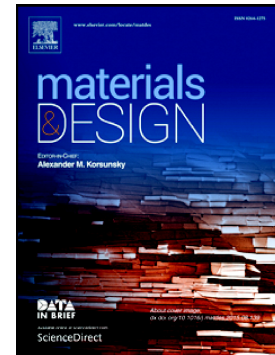


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Tailoring of magnesium aluminum titanate based ceramics from aluminum dross

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Abstract

Magnesium aluminum titanate ($\text{Mg}_{0.3}\text{Al}_{1.4}\text{Ti}_{1.3}\text{O}_5$ and $\text{MgAl}_8\text{Ti}_6\text{O}_{25}$) “MAT” based ceramics were successfully prepared by reaction sintering at a temperature of 1300 °C for 6h starting from aluminum dross waste and rutile ore powders. Different mixtures of dross-(0-60 wt %) rutile were prepared. The obtained ceramic composites were characterized by XRD and FE-SEM. Physical and mechanical properties of MAT based ceramics were also investigated as well as the linear thermal expansion. XRD data illustrated that the solid solutions of composition $\text{Mg}_{0.3}\text{Al}_{1.4}\text{Ti}_{1.3}\text{O}_5$ and $\text{MgAl}_8\text{Ti}_6\text{O}_{25}$ were initially formed in the specimen containing 10% rutile(R). Afterward, their amount increased with further addition of rutile up to 60%. The best values of densification parameters ($\approx 2.76 \text{ g/cm}^3$ bulk density and $\approx 12.46\%$ apparent porosity) were recorded for specimen containing 20% rutile. In contrast, 50% and 60% R added samples, which are mainly composed of $\text{Mg}_{0.3}\text{Al}_{1.4}\text{Ti}_{1.3}\text{O}_5$, $\text{MgAl}_8\text{Ti}_6\text{O}_{25}$ and traces of TiO_2 exhibited density of 2.31 g/cm^3 and 2.5 g/cm^3 , respectively. Moreover, the obtained samples present thermal stability even at high temperatures. No decomposition was observed over a range of temperature of RT-1200 °C. In addition, the TEC's of the obtained samples have lower values than those of AT ceramics. As a consequence, the solid state sintering of aluminum dross waste and rutile ore can be considered as a promising way to produce a new advanced ceramic materials based on MAT. Also, using this waste has two intrinsic impacts. One over the nature by reusing this waste and the second on production cost.

Keywords: Aluminum dross waste; Rutile ore; AT-MT (Al_2TiO_5 - MgTi_2O_5); Thermal expansion; Microcracks.

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