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# Effect of yttria on thermal stability, mechanical and in vitro bioactivity properties of hydroxyapatite/alumina composite

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**The phase stability, mechanical and in vitro bioactivity properties of hydroxyapatite/alumina composite with and without yttria were investigated. Hydroxyapatite without additives decomposed at 1300 °C to beta- and alpha-tricalcium phosphate and calcium oxide phases. Although alumina contributed to the mechanical properties of hydroxyapatite, it not only decreased the decomposition temperature of hydroxyapatite from 1200 °C to 900 °C and it's in vitro bioactivity property but also increased the decomposition ratio of hydroxyapatite. An improvement in the properties of hydroxyapatite/alumina composite was provided by yttria via inhibiting the solid-state reactions between hydroxyapatite and alumina via the formation of yttrium aluminum oxide and calcium yttrium trialuminum oxide phases. The maximum fracture toughness of 2.178 ± 0.251 MPam$^{1/2}$, microhardness of 4.947 ± 0.191 GPa, a compressive strength of 227.75 ± 27.87 MPa, and a three-point bending strength of 90.15 ± 6.93 MPa were achieved for hydroxyapatite/alumina composite containing 1.5 wt% yttria at the sintering temperature of 1200 °C. The relative density of 92.94 ± 0.11% was also attained. This ternary composite can potentially be used in the human body for load-bearing applications because of its sufficient mechanical and in vitro bioactivity properties with a decomposition ratio of 9.4%.**

**Key words: Hydroxyapatite, Alumina, Yttria, Sintering.**