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# Effect of two step sintering profile on hydrothermal ageing resistance of tetragonal zirconia ceramics

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**Abstract**

Tetragonal zirconia is known as 'ceramic steel' due to its excellent hardness and fracture toughness. However, at low temperatures (< 300 °C) and in the presences of hydroxyls, tetragonal zirconia transforms into monoclinic zirconia which leads to property degradation, a phenomenon known as low temperature degradation or hydrothermal ageing. This ageing hinders the wide-spread use of zirconia in biomedical applications. Amongst the strategies used to enhance the ageing resistant of zirconia, two-step sintering (TSS) is a promising approach to achieve high densification and finer grain size. In this study, TSS method was used to sinter 3 mol% yttria stabilized tetragonal zirconia polycrystalline (3Y-TZP) ceramic. Zirconia powder was uniaxial pressed followed by cold isostatic pressing and sintered at different TSS profiles. The samples were initially heated to first step sintering temperature ($T_1$) and held at that temperature for one minute and then cool down to a second step sintering temperature ($T_2$) and held at the second step sintering temperature for 5 hours ($T_1/T_2$). Hydrothermal ageing was conducted for 36 hours in an autoclave containing superheated steam at 180 °C and 10 bar pressure. Phase transformation was analyzed by using the XRD method. The figure shows the effect of ageing time and different sintering profiles on the ageing-induced monoclinic development in the ceramics. It was revealed that as the sintering temperature increased, this was accompanied by an increase in the monoclinic content. The monoclinic phase development trends for samples sintered using with sintering temperatures of (1500/1300), (1500/1200), (1500/1100) and (1450/1300) were similar i.e., increase with ageing time and reached a reached saturation level. However, sample sintered with sintering temperature 1400/1200 °C exhibited excellent resistant against ageing and hence this profile would be suitable for sintering of 3Y-TZP samples for biomedical applications.

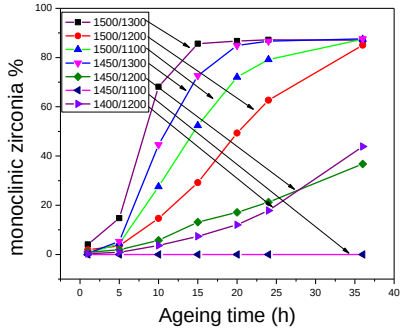


**Figure:** Effect of ageing time and sintering temperature on tetragonal to monoclinic phase transformation in 3Y-TZP ceramics