# Biscuit – sintered zirconia ceramics for dental applications

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The available literature data suggest that the differences in the elastic moduli between zirconia and dentine result in stresses at their interface that increase the possibility of a marginal seal failure. As a consequence, this can lead to the development of secondary caries and/or periodontal disease.

Objective: In the present work we report on the development of moderately porous Y-TZP ceramics with a reduced elastic modulus (E), while preserving its useful flexural strength ($\sigma$).

Methods: The so-called core-shell concept was adopted for the preparation of the starting materials. This concept exploits homo-aggregation, which results in a uniform distribution of nanosized particles attached to the surface of the submicron-sized particles in the slurry. After the slip casting, the green pellets were biscuit-sintered at various temperatures in the ambient air in order to obtain moderately porous zirconia samples.

Results: In the temperature region from 1000°C to 1400°C the nanostructured ceramic exhibits a lower densification rate in comparison with the dry-pressed sub-micron sized Y-TZP powders. In contrast, the flexural strength of the biscuit-sintered nanostructured material rapidly increases with the fractional density, starting from 80MPa at 55% of TD and reaching a plateau of 670MPa at 70% of TD. The highest increase, from 200MPa to 450MPa, was observed for a minimal increase in densification from 58% TD to 60% TD. The calculated dependence of E on the relative density shows that at 70% of TD the value is reduced from an initial 210GPa at >99% of TD to 70GPa. The empirical equations used are a reasonably good fit with the measured values.

Conclusion: We believe that the remarkable increase in strength is related to the larger area of the interparticle contacts. The addition of the nanoparticles enhances the formation of necks between the nanosized and/or the submicron-sized particles. At a TD of 70% the flexural strength almost doubles with respect to the conventionally used dry-pressed submicron-sized Y-TZP powder.