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Evaluation of phase quantification methods of dental Y-TZP after in vitro aging

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Purpose: The Garvie and Nicholson method modified by Toraya to quantify the Y-TZP phase transformation is widely accepted in literature. However, this method does not include the possibility of cubic phase transformation after aging, producing quantification errors. The aim of this study was to evaluate the aging kinetic of phase transformation of Y-TZP under hydrothermal conditions (130 °C, 2 bars) and compare the quantification methods by Garvie e Nicholson modified by Toraya with the Rietveld method.

Methods and materials: Discs of commercial Y-TZP (12 mm diameter × 1.2 mm height) were divided in groups ($n = 4$) from 6 to 138 h of aging. The crystallographic analysis was performed by XDR.

Results: The concentration of monoclinic phase increased up to 80% after 40 h of aging considering the peaks height and up to 70.9% calculating the area under the peaks using the Garvie and Nicholson modified by Toraya equation, compared to the 60% of monoclinic phase and 30% of cubic phase observed with the Rietveld method.

Conclusion: The texture and preferential orientation observed for the monoclinic peaks led to a higher percentage of monoclinic phase transformation using the Garvie and Nicholson modified by Toraya method. The Rietveld method showed a lower monoclinic phase transformation.

http://dx.doi.org/10.1016/j.dental.2013.08.006

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Effect of atmospheric pressure plasma on contact angle of zirconia

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Purpose: The purpose of this study was to investigate the effect of atmospheric pressure plasma application (AP) on contact angle of two zirconia ceramics.

Methods and materials: Five sintered zirconia plates (10 mm × 10 mm × 1 mm) of Katana (Kuraray Noritake) and Lava (3 M ESPE) were obtained using zirconium dioxide stabilized by yttrium oxide. The plasma torch (surface plasma tool model: SAP – Lab Applications) ran at room temperature (22 °C) and 20 mm long, using argon gas (Praxair 4.8) with 1.0 L/m output. The distance between the nozzle and the samples was 10 mm and the time of plasma exposure was 1 min for each treatment. Immediately after the exposition, a water drop of approximately 15–20 μL was placed on the zirconia surfaces. Contact angle data were analyzed by two-way ANOVA and Tukey test (5%). Measurements to evaluate the hydrophobic recovery of Katana and Lava zirconia were executed acquiring hourly the contact angle by Image J Software (National Institutes of Health). Profile images were acquired with a digital 300× microscope.

Results: The plasma treatment improved the wettability of the zirconia surface and the contact angles of both materials decreased around 50% if compared to the initial one. The stability of the surfaces reached a constant contact angle in approximately 12 h after treatment. In the comparison between zirconia ceramics in recovery speed perspective, Lava's hydrophobic recovery was faster than Katana.

Conclusion: AP pretreatment shows a possible technique to improve the bond strength between zirconia and polar resins, since the surface wettability increased after plasma exposure. Regarding the hydrophobicity recovery, both materials showed contact angle stability 12 h after AP treatment.

http://dx.doi.org/10.1016/j.dental.2013.08.007

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Slow crack growth in a veneering ceramic for zirconia after long-term water exposure

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Purpose: Characterize the complex stress corrosion fracture origins of a zirconia veneering ceramic after four years exposure to deionized water.

Methods and materials: Disc specimens (12 mm dia × 1.2 mm thick) of a veneer ceramic (Shofu Vintage ZR_System, Matsushita Ltd., JP) were sintered at 920-C and polished through 15-m diamond abrasive. The specimens were cemented (~0.1 mm thick Panavia F2, Kuraray) on 3.6-mm-thick Type 8000 epoxy resin substrates. Specimens ($n = 20$) were aged in individual cells with deionized water at 37-C. The solution volume was maintained over a four year period. Specimens were removed from water and air dried. Representative fractured veneer segments were removed carefully from the epoxy substrate, mounted and coated for SEM, yielding 18 fracture surfaces.

Results: All twenty veneer specimens fractured during the four-year exposure period. The majority of the crack initiation sites were near or at the water exposure surface. Typical fracture markings indicated that multiple fracture paths within each surface had initiated at one or more sites during stress corrosion. There was little evidence of traditional wake hackle given that the pores were partially or totally obscured by precipitates, and/or stress corrosion. SEM images revealed an