**1753 Water vapor effects on zirconia thin-film residual stresses**

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Previous research has shown that application of zirconia thin-films can increase the toughness of dental ceramics. To understand the mechanism of toughening, the residual stresses of material thin-film constructs and the subsequent modifications of these stresses due to environment effects must be evaluated. Objective: To evaluate the effects of water vapor absorption and thermal cycling on the residual stresses found in yttria-stabilized zirconia thin-films. Methods: 3 mol% yttria-stabilized zirconia (YSZ) thin-films were deposited using RF magnetron sputtering. The YSZ films were deposited on 10 cm Si wafers (5 – 25 mT, 25 – 300°C, and variable Ar/O₂ ratio). Stress states were immediately measured, using wafer bow measurements (WBM). Samples were aged (25°C, 75% relative humidity) and then stresses were re-measured every 5 min. for 2 hrs then every day for 30 days. Thermal treatment (100°C) tests were performed to model water vapor effects on residual stresses. Results: Stress measurements indicate that the YSZ films can have initial residual stresses ($\sigma_{RS}$) ranging from 111.1 MPa tensile (-) to 192.6 MPa compressive (+), depending on deposition parameters. Aging in an ambient environment led to large changes ($\sigma_{RS} = +32.8$ to $+120.1$ MPa) toward a more compressive stress state. Thermal treatment to remove absorbed water caused the films to return to initial stress states. Once exposed to ambient conditions, the measured stress was found to increase at a rate of 0.20 MPa/min. for the first 2 hrs of exposure then by approximately 2 MPa/day. Conclusions: The defect structure, types of crystalline phases present, and environmental exposure can have affect the direction (tensile and compression) and magnitude of stresses within the thin-film. The findings of this study indicate that residual stress states of YSZ thin-films are significantly affected by exposure to water, which might greatly influence their utility for in vivo applications. Supported by NIH-NIDCR DE13511-04.

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