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Residual Stresses Effects in the Indentation Fracture Toughness of Glass-Ceramics

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Residual stresses arise in glass-ceramics upon cooling due to thermal expansion and elastic mismatches between the crystalline and the amorphous phases and they are important for the overall mechanical performance of glass-ceramics. In this study, indentation fracture toughness of Li2O.2SiO2 and 2Na2O.1CaO.3SiO2 glass-ceramics were measured by Vickers indentation with the aim of studying the influence of residual stresses on contact damage in glass-ceramics. Samples of two precursor glasses were crystallized using two stage thermal treatments for nucleation and growth to obtain glass-ceramic materials with various crystalline volume fractions. The residual stresses are compressive for lithium disilicate crystals and tensile for the 2Na2O.1CaO.3SiO2 crystalline phase. Preliminary results show that samples of lithium disilicate glass-ceramics have a higher indentation fracture toughness compared with the glassy sample, while samples of 2Na2O.1CaO.3SiO2 glass-ceramics showed slightly lower indentation fracture toughness than that obtained for the glassy material. The final aim is to compare the results with theoretical toughening models and residual stresses measurements.