

RESIDUAL STRESS PROFILES IN ALUMINA-ZIRCONIA CERAMIC COMPOSITES FABRICATED BY TAPE CASTING

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Multilayer ceramics were initially developed as laminated structures for the packaging of microelectronics. However, improved mechanical performance made them interesting materials for structural applications. One of the most promising systems is alumina-zirconia. Different laminate designs and methods to obtain multilayer ceramics with controlled layer thicknesses have been developed.

Ceramic composites are fabricated by stacking together different tapes previously fabricated by tape casting. It has been found that even if tapes with the same composition are used to fabricate the ceramic structure, the composite has better mechanical properties than the monolithic piece. In general, authors suggest that this behavior might be due to the development of some degree of texture in the microstructure, due to preferential orientation of the grains in the tapes, and/or anisotropic residual stresses originated by the pressing procedure followed to stack together the different tapes. Nevertheless, no conclusive data have been provided.

In the present work, alumina-zirconia ceramic laminates are studied. Two different compositions within $\text{Al}_2\text{O}_3/\text{YTZP}$ (tetragonal ZrO_2 stabilized with 3 mol% Y_2O_3) system were investigated, containing 5 and 40 vol.% YTZP respectively. The processing route involved tape casting of individual tapes, stacking with gluing agent and pressing under low pressure to form the ceramic structure. Different stacking sequences were employed, including alternating layers of 5 and 40 vol.% YTZP. In addition, monolithic samples of the same composition were also fabricated for comparison. Through-thickness residual strain profiles were measured by synchrotron radiation in both phases (alumina and zirconia) along two directions: in-plane and normal. Measurements were performed in beamline ID15A (ESRF, Grenoble, France).

Previous measurements with neutron diffraction gave average strains through several ceramic tapes. However, in this case, the gauge volume (0.5x0.05 mm) and the step size employed (0.05 mm) are very small, thus allowing several measurements in each individual tape (approximately 0.5 mm thickness). This will provide additional data on the development of residual stresses in the ceramic composites, by probing the interaction between neighboring tapes.