Influence of porosity on mechanical properties of tetragonal stabilized zirconia

3YSZ specimens with variable open porosity (1–57%) were fabricated, and the stiffness, strength and fracture properties (fracture toughness and R-curve) were measured to investigate their potential use as support structures for solid oxide fuel or electrolysis cells. The ball-on-ring test was used to characterize Young's modulus and Weibull strength. The variation of fracture toughness with porosity was investigated and modelled using the results from fracture mechanical testing. A distinct R-curve behaviour was observed in dense 3YSZ specimens, in samples with a porosity around 15% and in some of the highly porous samples (porosities ~45%) reflecting a transformation toughening in the material. For the most porous samples, the "R-curve behaviour" disappeared and subcritical crack growth was observed. The studies indicate that even highly porous 3YSZ structures (porosities exceeding 40%) are feasible supports for SOFC/SOECs from a mechanical point of view.

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