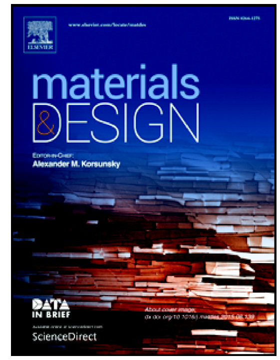

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Macro and micro collapse mechanisms of closed-cell aluminium foams during quasi-static compression

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Abstract

The pore collapse mechanisms of closed-cell aluminium foams during quasi-static compression have been investigated. A suite of experiments and numerical simulations were carried out to elucidate the deformation pathways of individual pores during quasi-static compressive loading. X-ray computed tomography was utilized to generate 3D views of the foams before and after deformation. The tomography based foam geometry was imported into the finite element software ABAQUS/Explicit for simulations. The results showed that the simulations accurately reproduced the experimentally observed yielding and post yielding behaviour of the foams. As expected, pores with thin cell-walls were observed to deform at faster rates both experimentally and in simulations. The simulations aided to reveal the complex deformation evolution of cell-walls and junctions (plateau borders) during compression. While the cell-walls experienced bending, buckling and rotation by forming hinges; the plateau borders experienced considerably less deformation. The thickness/strength of cell-walls and topological foams' heterogeneities are observed as the governing factors for collapse. Significant lateral strain is observed at the cell level, although the bulk lateral strain was negligible. Finally, it was also observed that the micro-pores and cracks present within the cell-walls contribute to their deformation.