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A Hybrid Approach for Consideration of the Elastic-Plastic Behaviour of Open-Cell Ceramic Foams

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Open-cell ceramic foams are used as filters during casting processes to reduce the non-metallic inclusions and the turbulence of the metal flow. Based on that, these foams have to withstand high temperature loadings and so elastic-plastic deformations can occur. The effective elastic deformation behaviour of such foam structures was investigated and described by Storm et al. [1], but the plastic deformation behaviour strongly depends on the microstructure and the bulk material plasticity, cf. [2] and [3], respectively.

The current work presents a homogenized material model based on an adapted yield function to describe the elastic-plastic deformation behaviour of open-cell structures. The form of the yield function is not specified completely a priori. The specific shape is interpolated between results of cell model simulations using neural networks [4]. This modelling approach is proved for simple plasticity models, e.g. von Mises and Drucker-Prager, and further applied to an exemplary foam structure using a simple bulk material plasticity. The proposed material model shows a good accordance for all tested elastic-plastic loading cases.

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