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ABSTRACT:

Microstructure-Informed Modelling of Open-Porous Materials

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The properties of open-porous cellular materials are guided by the spatial arrangement of their skeletal framework or network and their cell-wall morphologies. In this contribution, both these aspects will be discussed. First, the effect of the pore-network connectivity will be addressed. Here, the scaling exponent as observed in the power scaling relations between e.g., Young's modulus or the thermal conductivity vs. the relative density will be explored. While the open-cell foam model calculates the exponent to be 2 [1] for their Young's modulus, many porous materials demonstrate an exponent between 3 and 4 [2]. The morphological implications towards this observation will be illustrated through computational modeling and finite element calculations. Moreover, many open-porous materials show a pearl-necklace-like cell-wall morphology [3]. There, the inter-particle necks play a significant role in determining the mechanical features of such materials, particularly their mode of deformation and failure [4]. This aspect will also be explored in detail.

References

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[4] L. Ratke, A. Rege, S. Aney, The Effect of Particle Necks on the Mechanical Properties of Aerogels, Materials, 16 (2022).