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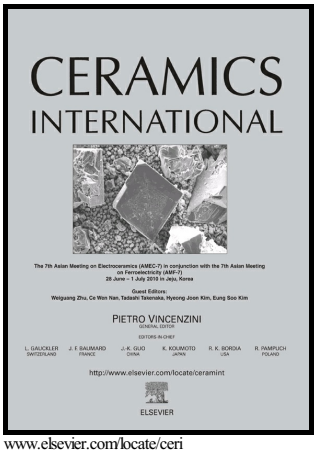


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# The modified Mori-Tanaka scheme for the prediction of the effective elastic properties of highly porous ceramics

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**Abstract**

In this paper, two modifications are proposed to be applied to the well-known Mori-Tanaka (MT) scheme to improve its performance in the estimation of the mechanical properties of highly porous ceramic structures containing complicated agglomerates of merged and open-cell spherical pores of different radii. In the first modification, the effect of the merged pores is considered by estimating their number with the theory of geometrical probabilities and treating them as corresponding ellipsoids of the same volume. In the second modification, porous structures containing open pores are treated as a damaged material with reduced load-carrying capacity and the formulations are modified to consider the effect of the open pores. In order to investigate the reliability of the analytical estimations, different groups of artificial porous structures with porosity values ranging from 10% to 90% are constructed by random positioning of the spherical voids of different radii in a representative volume element (RVE) and their effective elastic properties are obtained by means of the finite element method (FEM). For each level of porosity, a total of 30 random structures are examined to assess the variations caused by the statistical nature of the microstructure. Comparison between the findings of the statistical FEM and the analytical results show that the proposed modifications considerably increase the precision of the MT scheme in the estimation of the effective elastic moduli of highly porous materials. Furthermore, unlike the classical MT method, the modified formulations are capable of demonstrating of the probable anisotropy in the effective elastic properties of the porous structures. Good agreement is also observed between the results obtained from the developed formulations and published numerical and experimental observations for ceramic structures.