Abstract

Estimating Conductance in Small Samples of Heterogeneous Materials by Random Walks

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The conductance of a small specimen of heterogeneous conductor relative to the conductance of a specimen of pure conductor of the same size and shape can be estimated through means of path-based properties of simple random walks. The procedure can be applied to any specimen whose internal structure is known, and does not require any assumptions regarding symmetry of structure or the size of heterogeneous inclusions. It generalizes methods for determining the effective resistance of a circuit from lattices to continuous specimens, and, when employed upon regular arrays of spheres, produces results statistically indistinguishable from those obtained by asymptotic methods. It is of potential use in the study of small samples of highly heterogeneous materials in which effective medium theories and similar asymptotic methods would be invalid.

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