# Thermal conductivity of solids with coalescing spherical pores

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The overall thermal properties of media containing insulating cylindrical inhomogeneities has been addressed recently in [1] making reference to a 2D layout. There, the cross section of the fibers is formed by two intersecting circles to simulate a variety of nonconductive fibers (e.g. electrospinned polystyrene fibers). On the other hand, intersecting circles is a relevant layout to assess the physical properties of a variety of porous materials (e.g. Gasar metals) during the processes of pore coalescence and growth.

In this work we extend the analysis addressed in [1] to a 3D framework by considering the effect of insulating inhomogeneities having the shape of intersecting spheres. The analysis aims at assessing the second-order resistivity contribution tensor $\boldsymbol{R}$

$$\Delta(\nabla T) = \frac{V_*}{V}\boldsymbol{R}\cdot\boldsymbol{q}, \tag{1}$$

which provides the corrective temperature gradient induced by the volume $V_*$ of the inhomogeneity over the reference volume $V$ of the background material subjected the a remotely applied heat flux $\boldsymbol{q}$. Owing to the geometric setting, reference is made to toroidal coordinates and Mehler–Fock transforms are used to represents the perturbation temperature field due to the inhomogeneity [2]. As remarked in [3] for coalescing spheres having the same diameter, the components of tensor $\boldsymbol{R}$ display a nonmonotonic trend varying the distance between their centers. In particular, unlike what is observed for spheroids, the stationary values of the components of tensor $\boldsymbol{R}$ occur when spherical pores are slightly intersecting.

*References*

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