Temperature Fields Generated by a Circular Heat Source (CHS): Solution of Two Different Semi-Infinite Media

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Previous papers on circular heat sources (CHS) described the transient 3-dimensional temperature fields created by a CHS embedded inside two identical and isotropic semi-infinite media [1], when thermal contact resistances (CRs) are present between the CHS surfaces and the isotropic semi-infinite media [2], and in the case of a CHS embedded between two anisotropic (orthotropic), identical semi-infinite media with CRs on both surfaces [3]. In this paper, the case of a CHS embedded inside two isotropic but different semi-infinite media is discussed. This setup is useful when only a single sample is available for measurement. Two different time-dependent temperature fields are derived for the semi-infinite media, as well as their corresponding heat fluxes. The derivation of the 3D solution uses first principles with no prior assumptions, and employs the Hankel and Laplace transforms. The Laplace inversion theorem is used to find the inverse Laplace transform of the temperature and flux functions, since no tabulated inverse transform functions are available for this case. The solution is exact with no approximations, but is given in an integral form, and must be evaluated numerically.