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Heat transfer from a particle in creeping flow of a variable-conductivity fluid ESMAEIL DEHDASHTI, Michigan Tech, MEGHDAD RAZIZADEH, Lehigh University, HASSAN MASOUD, Michigan Tech — We revisit the classical problem of heat transfer from a single particle in a uniform Stokes flow with the assumption that the fluid conductivity changes linearly with the temperature. We use a combination of asymptotic analysis and numerical simulation to derive semi-analytical expressions for the dimensionless heat transfer coefficient, i.e. Nusselt number (Nu), of spheroidal particles. The results cover the entire range of Peclet number (Pe). We find that, for a constant temperature boundary condition and fixed geometry, the Nusselt number is essentially equal to the product of two terms, one of which is only a function of Pe while the other one is nearly independent of Pe and mainly depends on the proportionality constant of the conductivity-temperature relation. We also show that, in contrast, when a uniform heat flux is imposed on the surface of the particle, Nu can be written as a summation of a Pe dependent piece and one that solely varies with the proportionality constant. Finally, we discuss the extension of these results to non-spheroidal particles and to finite-Reynolds-number flows.

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