

Abstract Submitted
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Ballistic thermophoresis on graphene¹ ERIO TOSATTI, EMANUELE PANIZON, ROBERTO GUERRA, SISSA — The textbook thermophoretic force acting on a diffusing body in a fluid is proportional to the local temperature gradient. Not so for a diffusing physisorbed body on a submicron sized 2D suspended layer. A non-equilibrium Molecular Dynamics study of a test nanosystem - a gold nanocluster adsorbed on a single graphene sheet of length L clamped between two temperatures ΔT apart - reveals a phoretic force that is parallel to, but essentially independent of, the gradient magnitude $\Delta T/L$ up to a substantial L of up to 150 nm. This is argued to represent ballistic thermophoresis, where the force is provided by the flux of massively excited flexural phonons, whose flow is in turn known to be ballistic and distance-independent up to relatively long scattering lengths before the eventual onset of the more standard diffusive regime. The surprising thrust and real momentum provided by the flexural modes are analysed and understood in terms of the large mass non-uniformity involved with these modes. The ensuing surf-riding of adsorbates on the vibrating 2D hard sheet, and the resulting gradient independent thermophoretic force, are not unlikely to possess practical applications.

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