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Electron drag at liquid-graphene interface

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The behaviour of a fluid confined at the nanoscale is dominated by its interaction with the confining solid walls. While the structural properties and chemistry of the solid-liquid interface are now well known to play a key role in the properties of nanoscale flows, few studies have been done up to now on the effect of the solid-state electronic properties of the interface. In this context, it has been demonstrated that water flowing against the surface of carbon-based materials such as graphene sheets or carbon nanotubes, induces an electric current flowing between the upstream and downstream sides of these materials, but the exact mechanism at stake is still largely debated [1].

Here we use a tuning fork-based Atomic Force Microscope to deposit and put into motion an ionic liquid droplet over graphene flakes of various thicknesses, while recording the induced alternating electric current flowing through the graphene sample. We report measurements of generated current amplitude several orders of magnitude larger than previous measurements implying water-salt solutions [2,3], thus revealing a specific ionic liquid-graphene interaction that cannot be rationalized by standard mechanisms. Our results also show that current generation strongly depends on the flake thickness as well as on the DC bias voltage, thus highlighting the modalities for the coupling between the ions in the fluid and the charge carriers in the graphene.

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