Molecular streaming and voltage gated response in Angström scale slits

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The field of nanofluidics has shown a great development over the past decade thanks to key instrumental advances, leading to a number of exotic transport behaviours for fluids and ions in extreme confinement [1-2]. Recently, van der Waals assembly of 2D materials allowed the fabrication of artificial angstrom scale channels that can be used for molecular confinement. This ultimate size reduction indeed revealed original behaviours for both mass [3] and ionic [4] transport. In this work, we report ionic molecular streaming induced by coupled pressure and voltage forcing. Under pressure and voltage forcing, we observe a new hydro-electric coupling leading to a gating-like response of the molecular streaming. This effect, observed with both boron-nitride and graphite slits, is found to be material dependent and related to the salt concentration in the channel. A potential difference of a fraction of a volt results in a mobility up to 100 times larger than the potassium mobility. This corresponds to an equivalent zeta potential three orders of magnitude higher than the gating voltage (higher than 100 V). Our results suggest that molecular scale confinement may lead to new flow control mechanisms.

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