Understanding water transport through graphene-based nanochannels via experimental control of slip length

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Abstract:

The water transport along graphene-based nanochannels has gained significant interest. However, experimental access to the influence of defects and impurities on transport poses a critical knowledge gap. Here, we investigate the water transport of cation intercalated graphene oxide membranes. The cations act as water-attracting impurities on the channel walls. Via water transport experiments, we show that the slip length of the nanochannels decay exponentially with the hydrated diameter of the intercalated cations, confirming that water transport is governed by the interaction between water molecules and the impurities on the channel wall. The exponential decay of slip length approximates non-slip conditions. This offers experimental support for the use of the Hagen-Poiseuille equation in graphene-based nanochannels, which was previously only confirmed by simulations. Our study gives valuable feedback to theoretical predictions of the water transport along graphene-based channels with water-attracting impurities.

Keywords: Graphene oxide membrane, cation intercalation, water transport, slip length