A SCALING LAW FOR CHARGE TRANSPORT IN LAYERED 2D MATERIALS AND ITS APPLICATION TO REDUCED GRAPHENE OXIDE

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Advancements in the field of layered 2D materials not only open new venues for novel applications but they also bring new questions for basic science such as the possible scaling laws for transport in multilayer 2D materials. In terms of dimensionality, these materials lie between 2D and 3D. In addition, they are strongly anisotropic, that is interlayer interactions are much weaker than the intralayer ones. These van der Waals interactions define an extra transport length scale, interlayer diffusion length, which further complicates the transport phenomenon [1]. Motivated by these, we investigate charge transport in multilayer reduced graphene oxides (rGO). Multilayer rGO contain substantial amounts of disorder, which play a major role in transport. We follow a multiscale computational approach bridging first-principles calculations with large scale transport simulations, and investigate the relevant transport scaling laws. We observe a reversal in the hierarchy of transport regimes, between diffusion and localization. Namely, transmission in the localization regime can be higher than the values predicted by the diffusion formula. We also derive a scaling law for resistivity, depending on the number of layers. Our predictions compare very well with the experimental data [2]. Lastly, we show that the multilayer scaling law is valid not only for rGO but other multilayer 2D materials as well.

References

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