Proton transport through 2D crystals – high resolution mapping and electric field effects

Marcelo Lozada-Hidalgo
The University of Manchester, Manchester, UK
Marcelo.lozadahidalgo@manchester.ac.uk

Graphene, a one-atom-thick sheet of carbon atoms, is completely impermeable to all atoms – even helium, the smallest – under ambient conditions. Nevertheless, it is highly permeable to thermal protons [1]. This finding opened a debate on whether the proton permeability was due to vacancies, which remained in stalemate for almost a decade.
In this talk we'll discuss our recent work mapping proton transport currents in graphene with nanoscale spatial resolution, which unequivocally confirm that perfect graphene crystals are permeable to protons [2]. We have also found that the same holds for the much more disordered material graphene oxide, albeit only under small scale areas [3]. We will also discuss some of our recent work investigating the correlation between proton and electronic transport. Specifically, we'll discuss the role of electric fields in accelerating interfacial water dissociation [4] in graphene electrodes and how field effects can control the acceleration of protons through graphene under illumination [5,6].

References

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