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A proton conductive graphene composed membrane for direct methanol fuel cell (DMFC)

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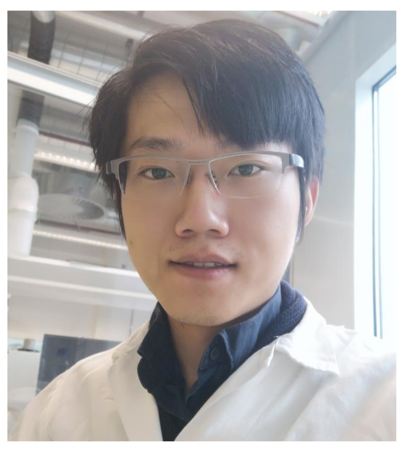
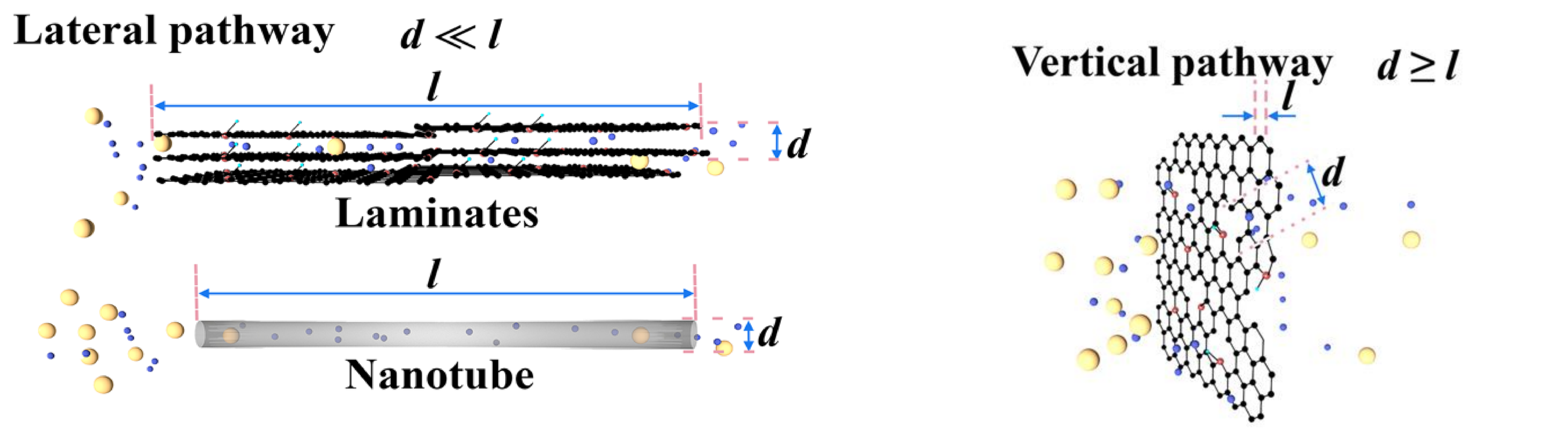
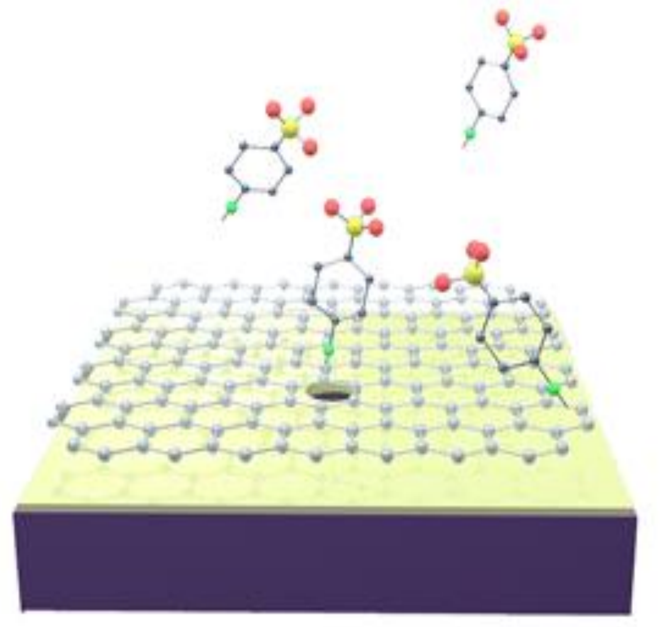


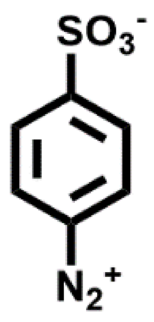
2D porous membrane



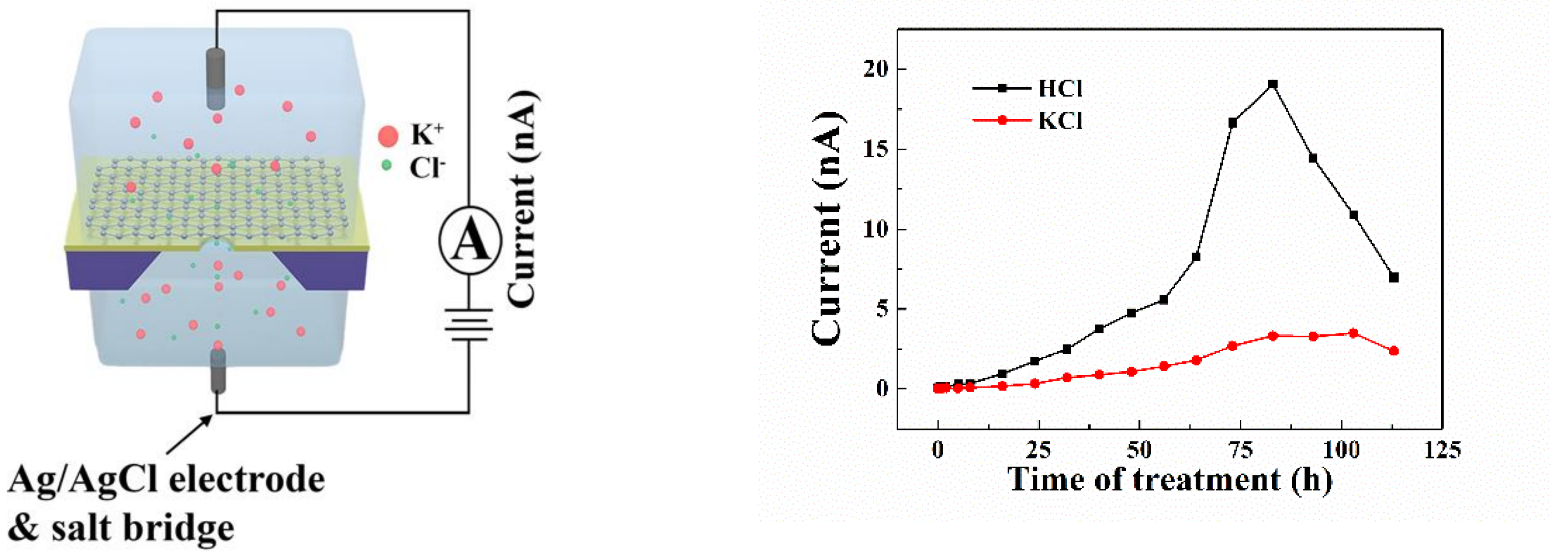
Shortening transport distance to **atomic size** endows possibilities for membrane of new generation while 2D membrane with high proton permselectivity remains challenging[1-5].

Proton conductive graphene

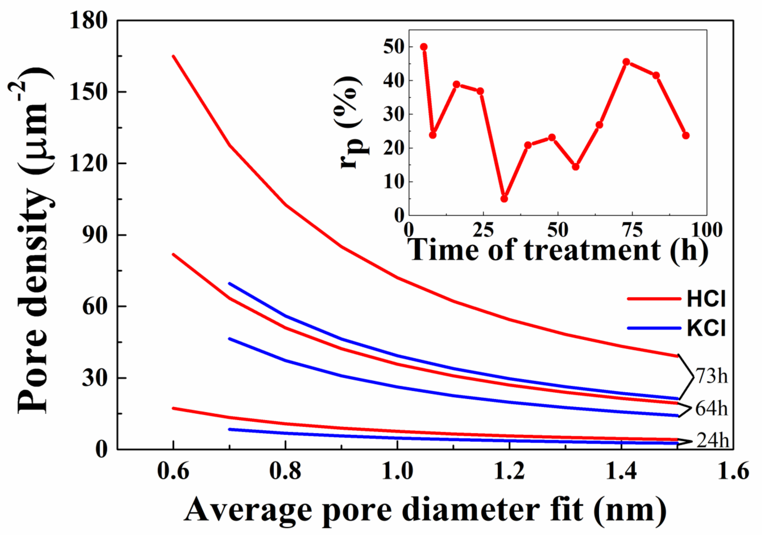




Illustrate: SBD treated graphene. High quality graphene fixed at SiN/Si chip with 1 μm aperture.



Ionic current measurements tracked the conductance variation with treatment time in 0.1 M solutions.

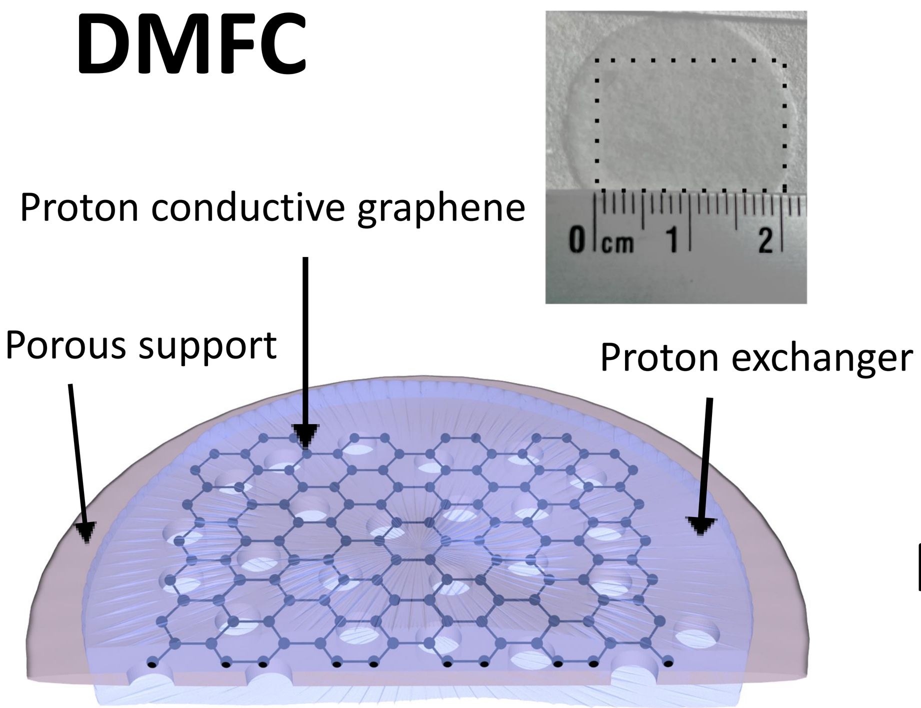


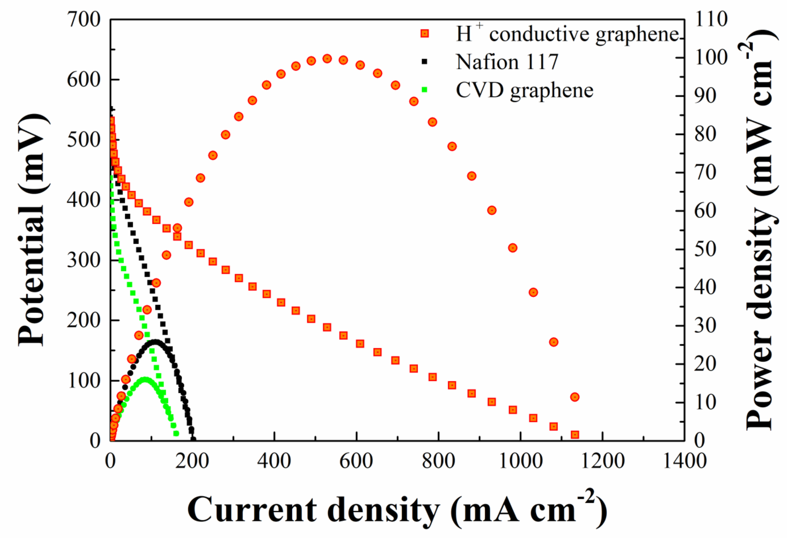
Pore density. a, Pore density as a function to assumed pore diameter, Inset: ratio of pores only allow proton passage which indicates the H^+/K^+ selectivity.

Proton selectivity up to **~48%** with respect to K^+

Conductance reaches **18 s cm^{-2}** in 0.1 M HCl

Proton conductive graphene membrane in DMFC

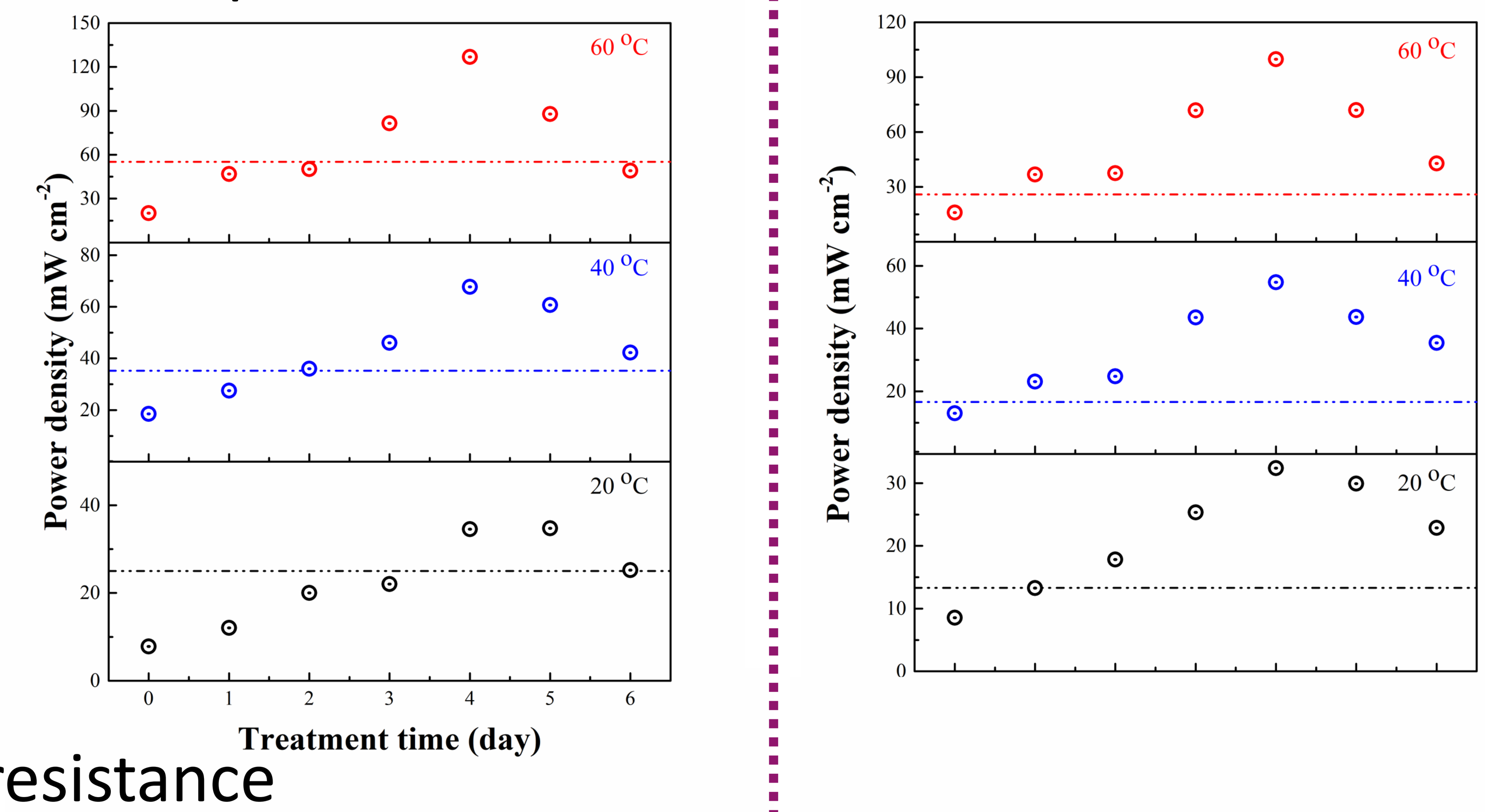




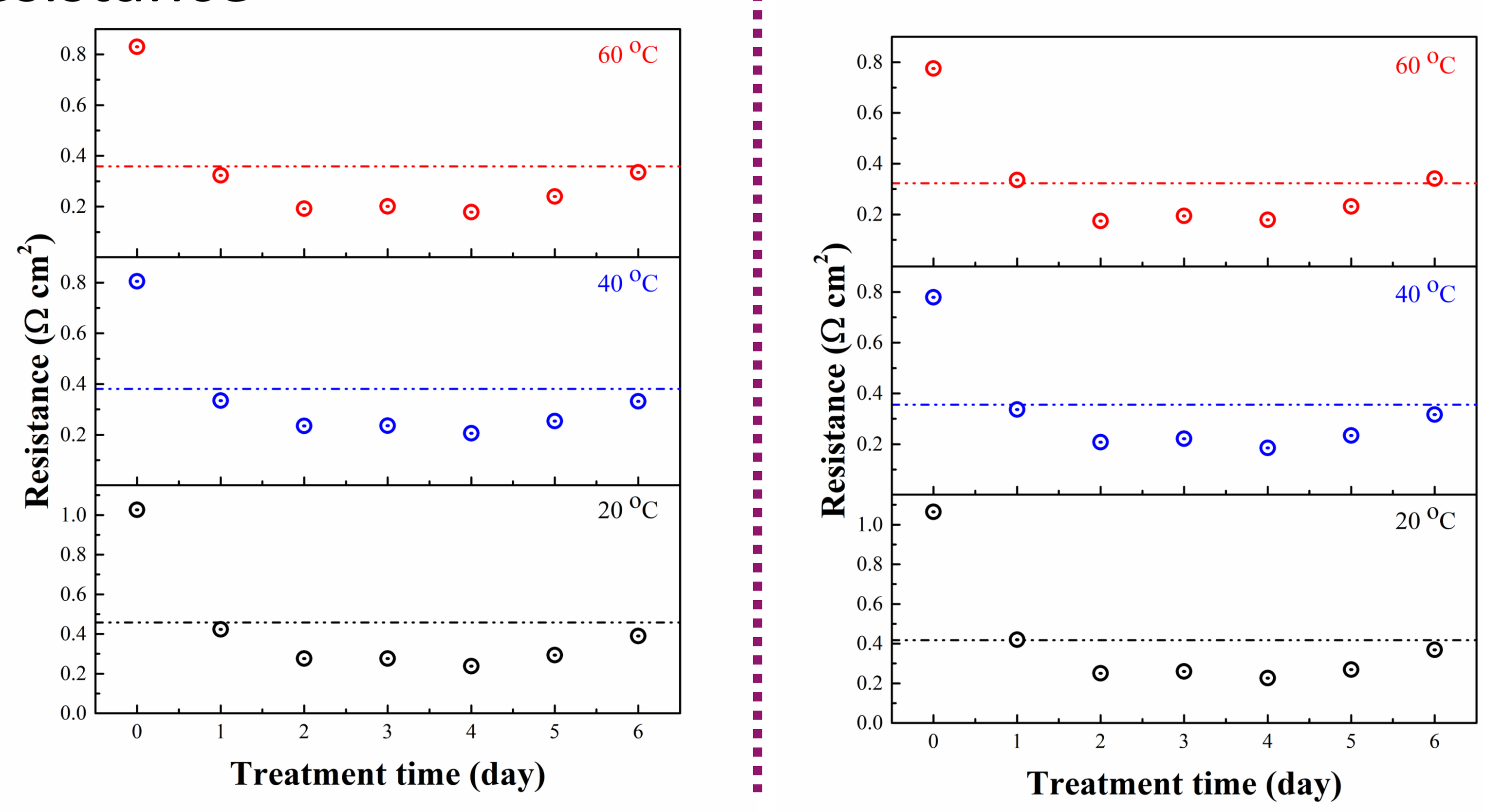
Polarization and power density at 60 °C with 5 M methanol

Max. power output

1 M methanol | 5 M methanol



Proton resistance



Dash lines indicate data obtained from Nafion 117

Conclusion

In this work, diazonium treatment as a facile method was applied for proton conductive graphene fabrication which is suitable for the large-scale membrane applications. As-treated graphene reaches 18 s cm^{-2} in 0.1 M HCl with high proton selectivity. Such proton conductive graphene composed membrane boosts ~4 times power output comparing with Nafion 117, and it is also less sensitive to methanol concentration.

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