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Microfluidic Water Splitting Platforms

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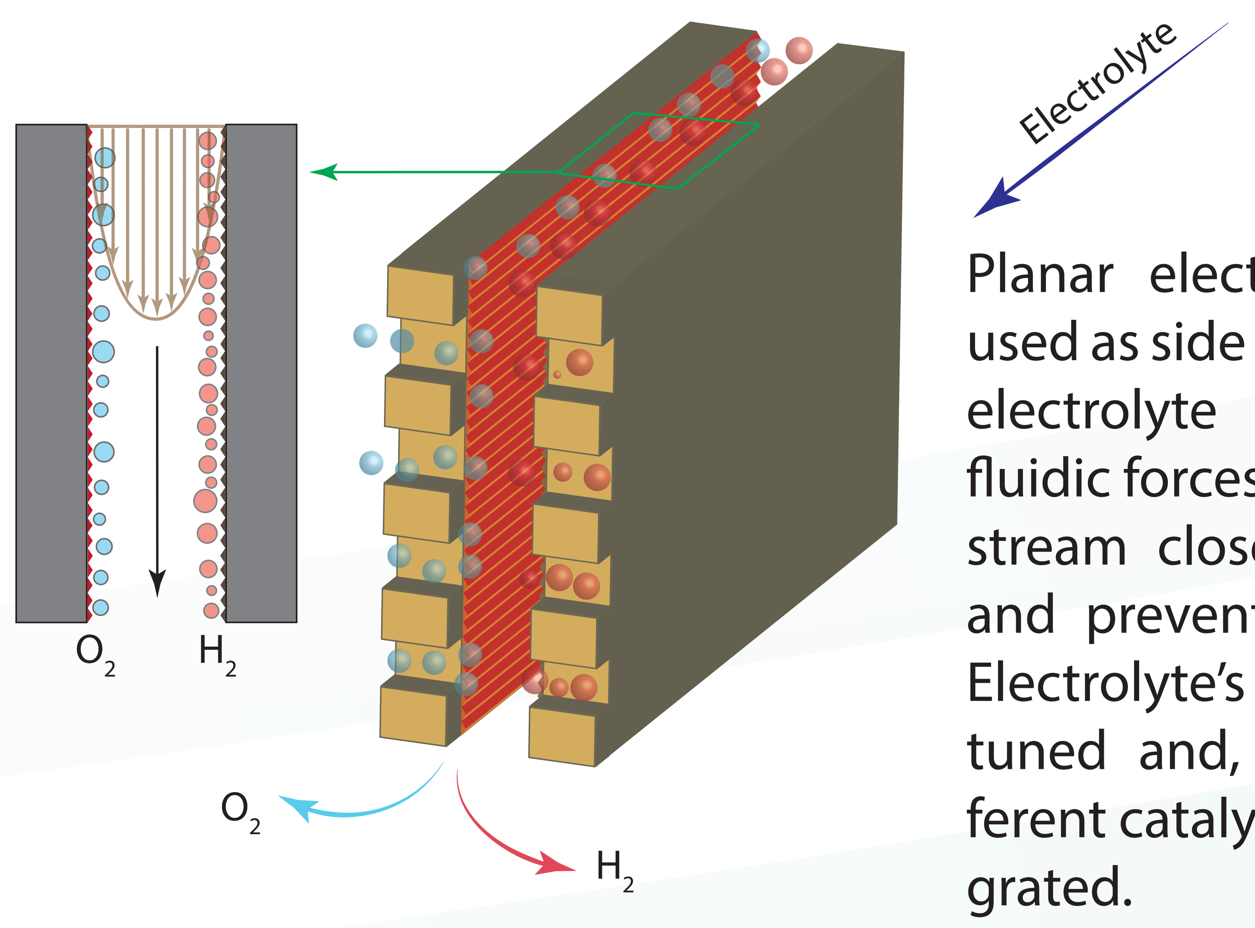
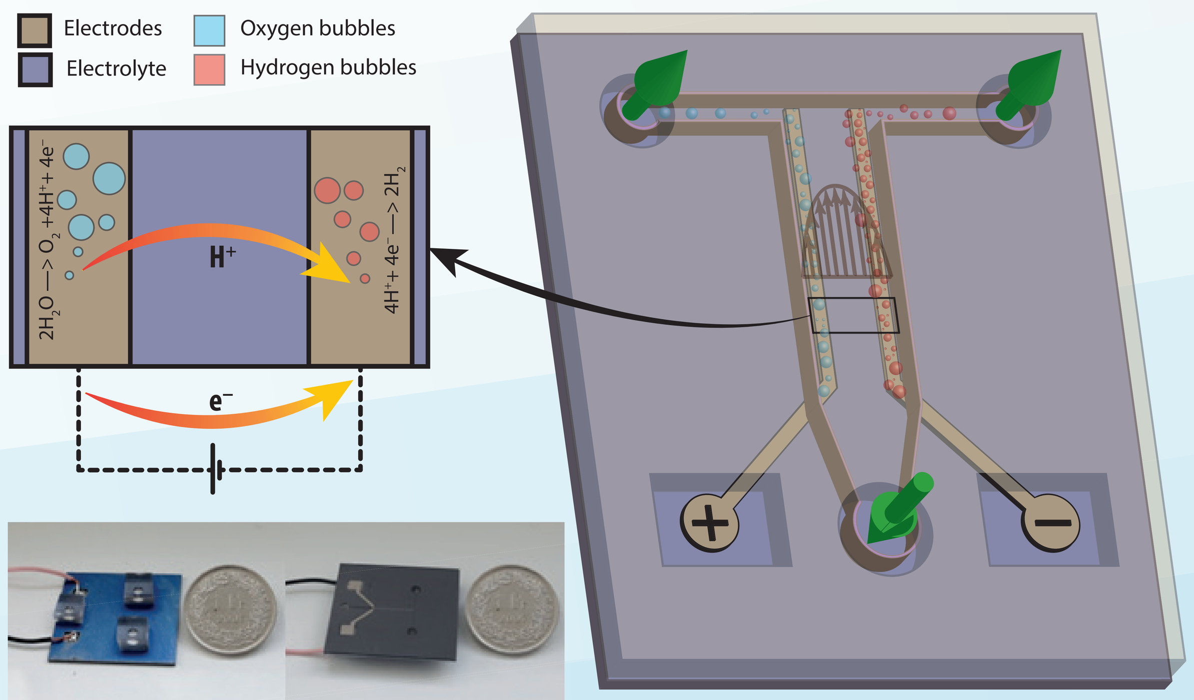
A membrane-less and a room-temperature microstructured vapor-fed electrolyzer have been demonstrated. The membrane-less device removes the need for an ion conductive membrane by using fluid mechanic forces in the laminar flow of a liquid electrolyte for gas separation. The vapor-fed device takes in the ambient air and splits its water content to produce hydrogen fuel.

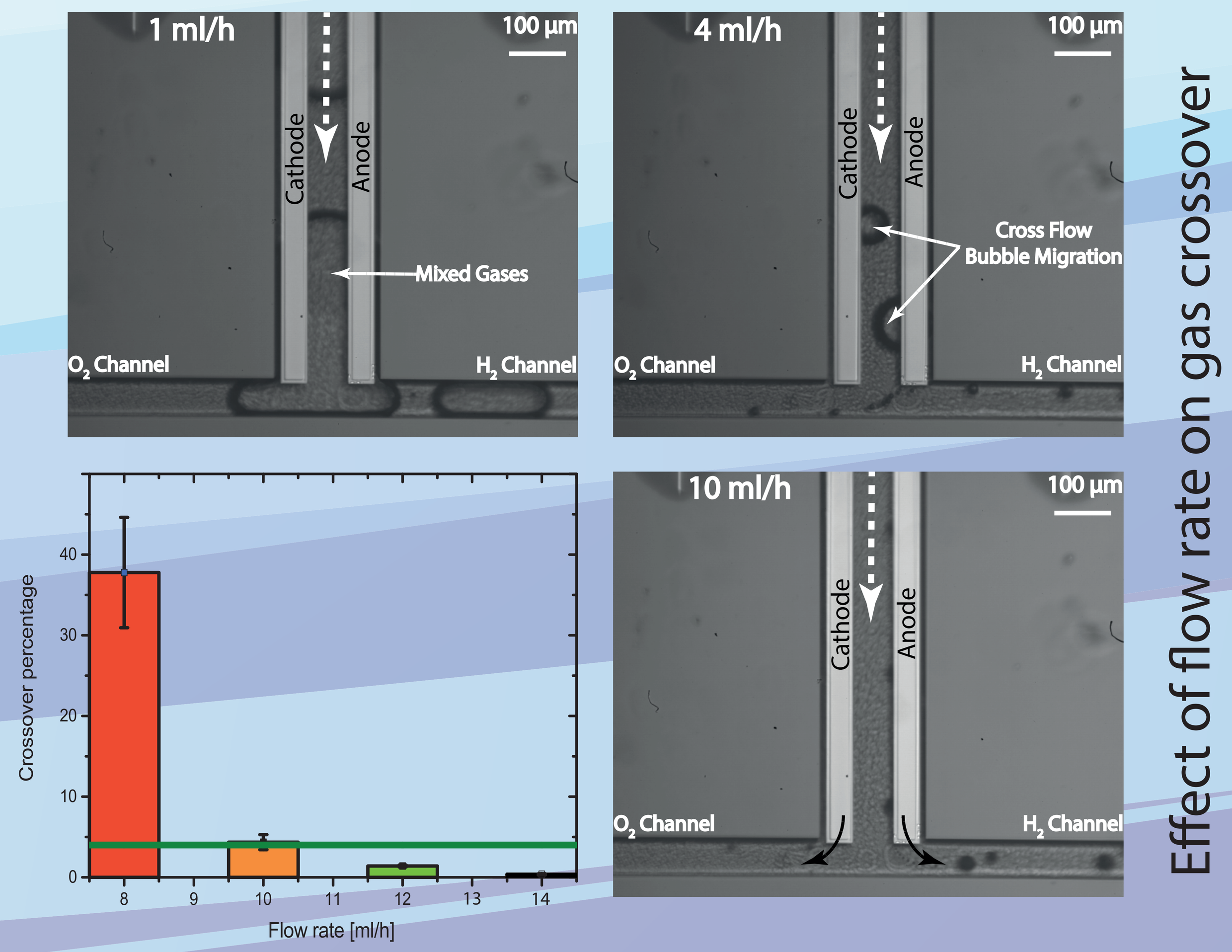
Membrane-less Electrolyzer

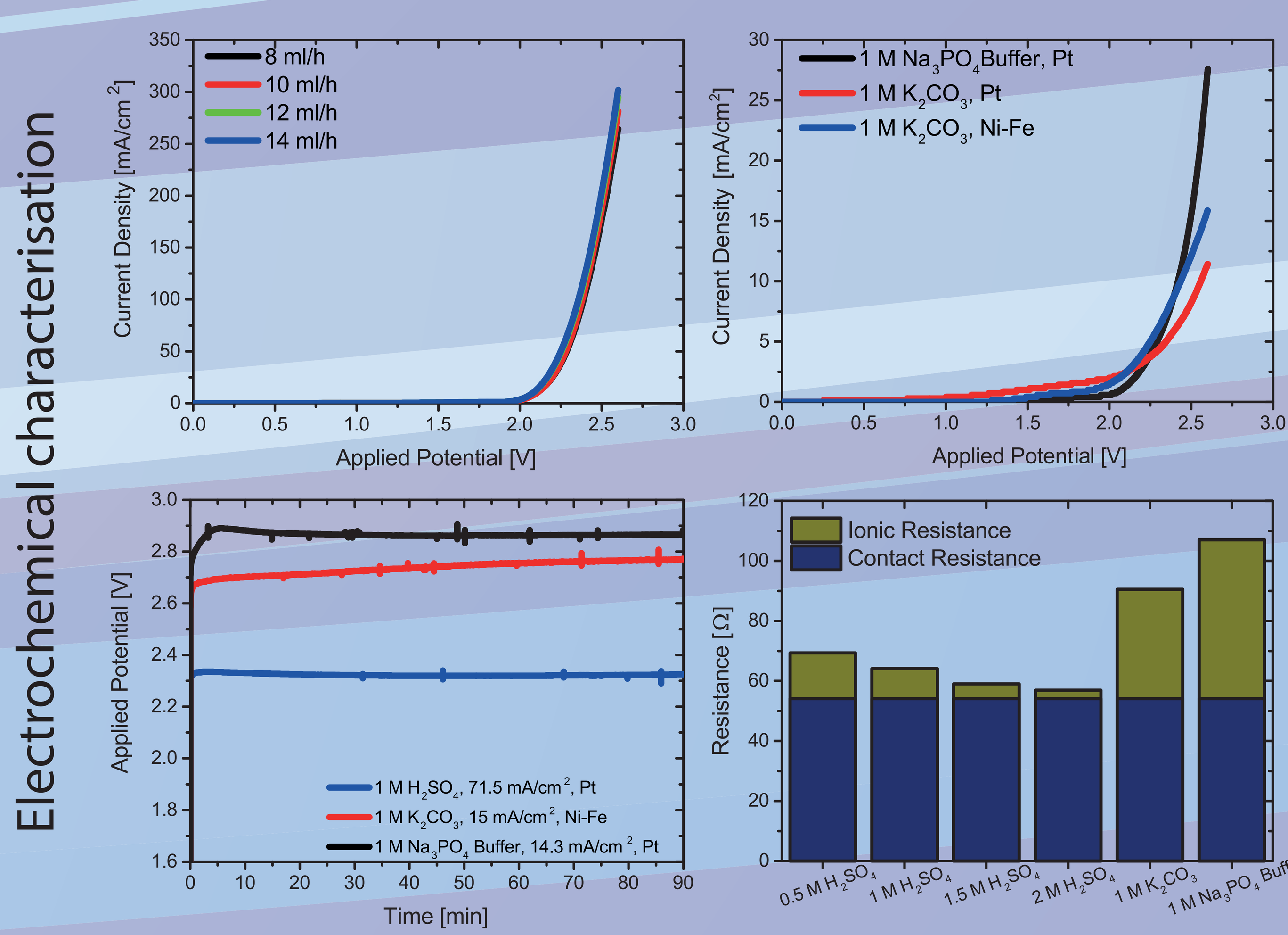


Planar electrodes can be used as side walls of narrow electrolyte channels. The fluidic forces keep each gas stream close to the walls and prevent their mixing. Electrolyte's pH can be tuned and, therefore, different catalysts can be integrated.

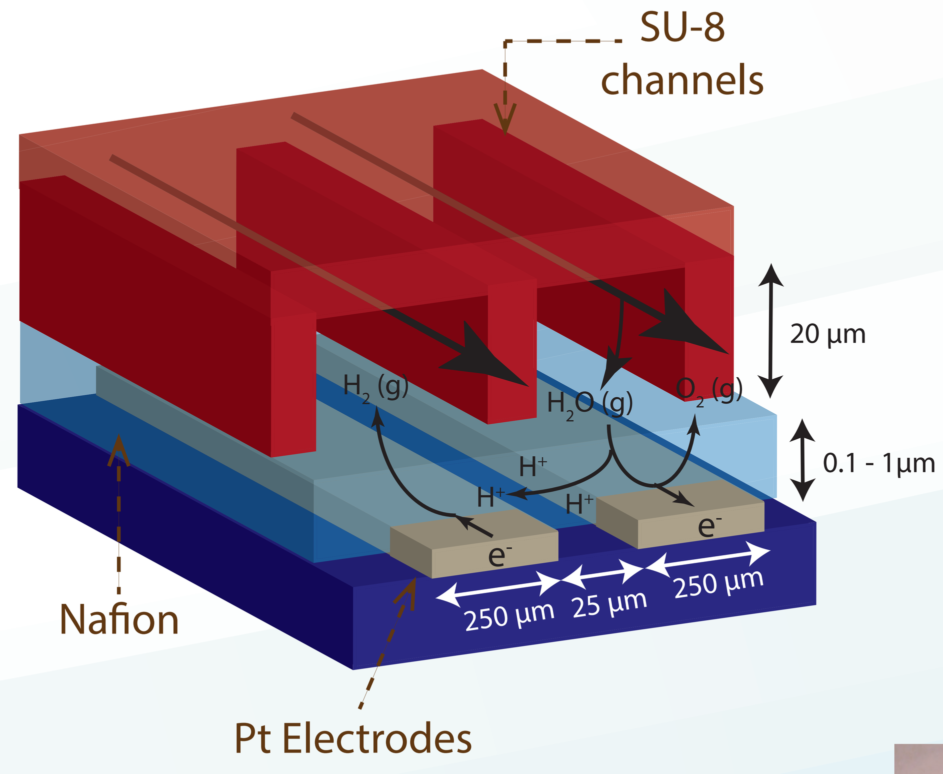
Schematic of the proof of concept device is presented together with the pictures of the final device at the inset.





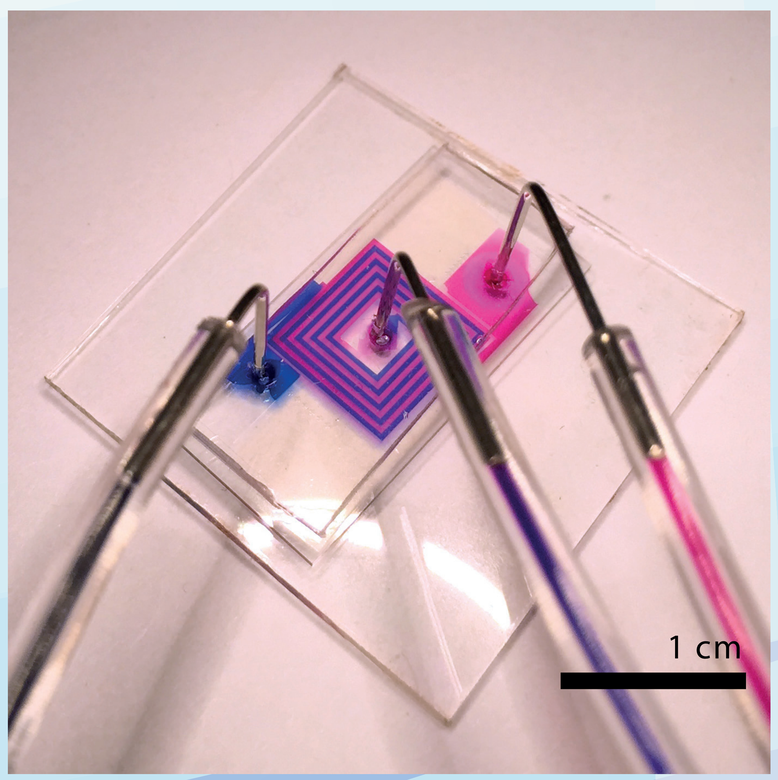


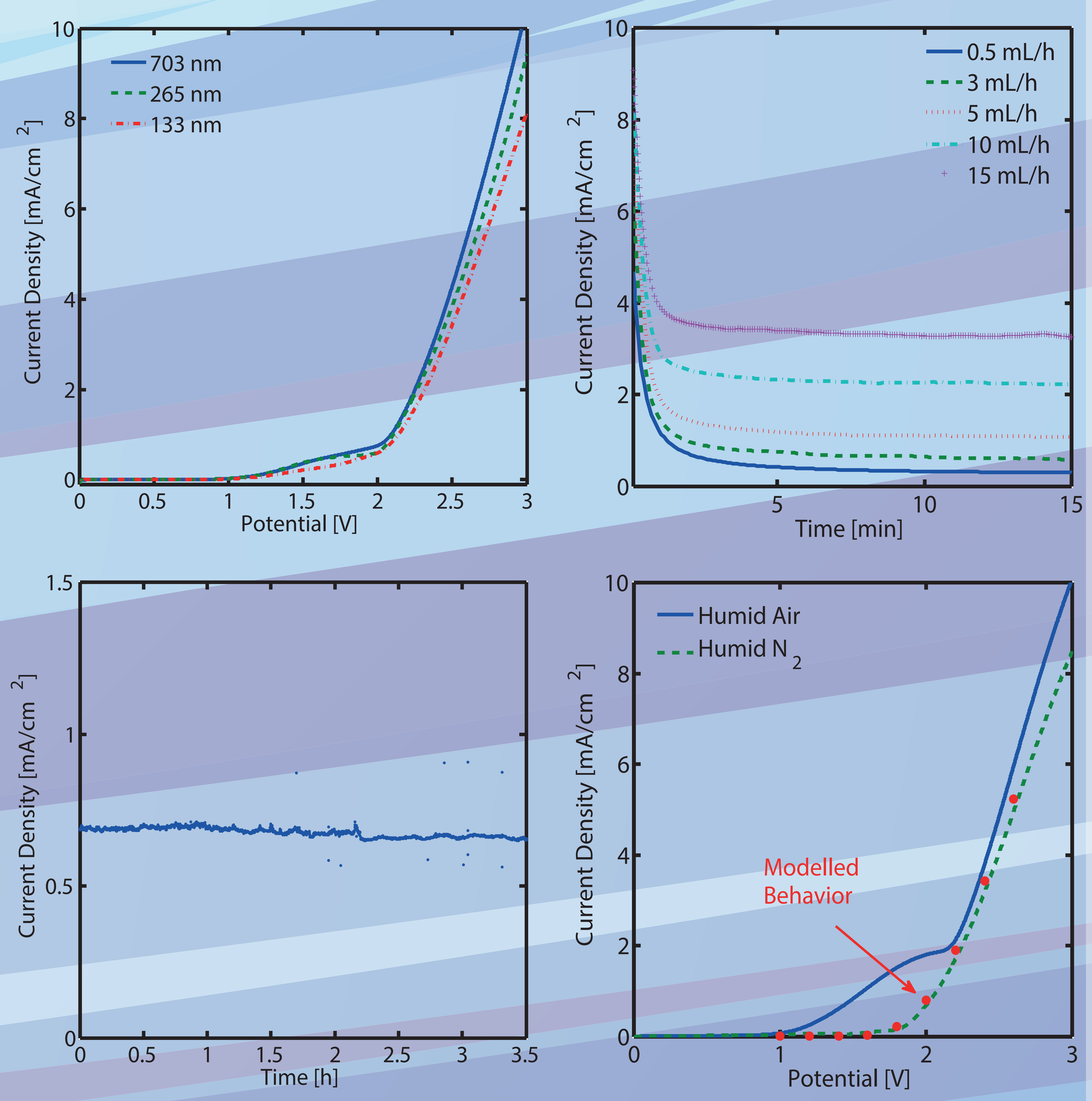
Vapor-fed Electrolyzer



The water content in a stream of air diffuses into a Nafion layer, where it splits at the surface of electrocatalysts. The evolved gases diffuse back into channels and the ions move inside the Nafion thin film.

The double spiral channels are used to avoid multiple fluidic inlets and outlets. The air flows in from the central port and the gases are collected from the side ports.





Performance characterisation: a. As the membrane gets thicker, its ionic resistance decrease and leads to higher current density. b. Higher flow rates alleviates the transport limitation to and from electrodes. c. Device performs stably over course of hours. d. Some of the current is used by the parasitic oxygen reduction reaction.

Hosseini Hashemi, S. M., Modestino, M. A., & Psaltis, D. *Energy and Environmental Science.* 2015

Modestino, M. A., Dumortier, M., Hosseini Hashemi, S. M., Haussener, S., Moser, C., & Psaltis, D. , *Lab on a Chip.* 2015