

Virtual Breakdown Mechanism: Field-driven Pure Water Splitting for Hydrogen Production

Yifei Wang

November 18th, 2016



Highlights



- Break through the common sense that even pure water can be conductive, and electrolyzed.
- Put forward a novel theory, named "virtual breakdown mechanism".
- This mechanism can be applied on ultrafast charging, alcohol electrolysis, carbon-dioxide reduction, fuel cells and so on.
- This work is to be submitted to *Science*.
- Wang, Yifei, et al. arXiv. 2016.(<u>1611.04677</u>)
- Wang, Yifei, *et al. JVSTB.* 2015. (<u>10.1116/1.4930298</u>)
- U.S. Provisional Patent Application No. 62/341,427, 2016. (Filed)



Project goal







Mechanism







Virtual breakdown mechanism







Devices Fabrication







Devices Fabrication





- Sandwiched-like nanogap electrochemical cells
- > Gap distances (nitride thickness) range from 37 nm to 1.4 μ m.
- The whole process is yield-controlled and can be scalable to mass manufacturing.



Characterization



I-V curves measurement of pure water



Electron-transfer limited reaction



Pure water vs. NaOH solution



More than 10⁵-fold enhancement of pure water conductivity



Even pure water can be conductive, and electrolyzed!





Thanks for Attention!

For more information: <u>yifeiwan@usc.edu</u>

