Particle/Polymer Nanofiber Mat Electrodes for Hydrogen/Air Fuel Cells

Peter Pintauro
Department of Chemical and Biomolecular Engineering
Vanderbilt University
Nashville, TN, 37235 USA

The commercialization of proton exchange membrane (PEM) hydrogen/air fuel cells is hampered by the high price of the carbon-supported Pt powder catalyst that is used as the electrode material in these devices. Conventional Pt/C-based fuel cell cathodes also suffer from long-term durability issues due to Pt dissolution and carbon corrosion. One approach to reduce the amount of Pt in a PEM fuel cell without a loss in power output and with better long-term performance is to improve the electrode morphology in order to maximize catalyst contact with feed gases and quickly remove product water, while maintaining a sufficient number of pathways for proton and electron conduction. Electrodes with such properties can be created by electrospinning, a scalable, robust, and cost-effective process for fabricating non-woven mats of sub-micron diameter fibers. For fuel cells, particle/polymer nanofiber electrospinning offers the possibility of creating high performance electrode structures from a wide-range of polymeric binders and catalytic powders. In this talk, recent work on the electrospinning of particle/polymer fiber mat electrodes will be presented, with a particular focus on improving the performance of the oxygen cathode in a hydrogen/air PEM fuel cell. Procedures for fabricating high particle-loaded nanofibers with a polymer binder will be presented and the structure of the fibers will be described. The effects of catalyst type (carbon supported Pt and Pt-alloy catalysts), catalyst loading, and choice of binder on fuel cell power output and cathode durability will be discussed.

Bio:

Peter Pintauro is the H. Eugene McBrayer Professor of Chemical Engineering in the Department of Chemical and Biomolecular Engineering at Vanderbilt University. He received B.S. and M.S. degrees in Chemical Engineering from the University of Pennsylvania and a Ph.D. from the University of California, Los Angeles. He joined the faculty of Tulane University in 1986, where he rose to the rank of Professor of Chemical Engineering in 1994. In July 2002, he moved to Case Western Reserve University, as Chair of the Department of Chemical Engineering, and was appointed Kent Hale Smith Professor of Engineering in October 2004. From 2008 until 2013, he was Department Chair at Vanderbilt. His research interests are in the areas of electrochemical engineering, membrane science, nanofiber electrospinning, and organic electrochemical synthesis. He is a Fellow of the Electrochemical Society, a Fellow of the American Institute of Chemical Engineers, a past President of the North American Membrane Society, and the 2018 recipient of the U.S. Department of Energy's Fuel Cell R&D Award.