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ONLINE EDUCATIONAL EXPERIENCES WITH “CLEAN ENERGY: HYDROGEN/FUEL CELLS”



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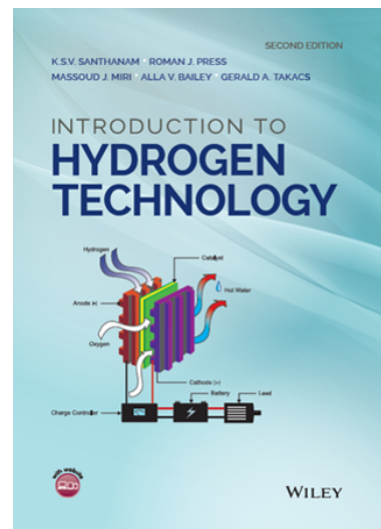
Online Educational Experiences with “Clean Energy: Hydrogen/Fuel Cells”

Synopsis:

For over 14 years, educational programs were developed to educate undergraduate students, and High School teachers and students in the field of: “Clean Energy, Electricity Generation Using Fuel Cells”. During the COVID-19 pandemic, the program was converted to K-12 online learning.



RIT in :30 - Science of Fuel Cells



Online Educational Experiences with “Clean Energy: Hydrogen Fuel Cells”

With growing concern about climate change, renewable energy sources, and solutions to the ever-increasing demand for energy, educational programs were developed at RIT to educate undergraduate students, and High School teachers and students in the field of “Clean Energy, Electricity Generation Using Fuel Cells”.

Since 2008, introductory educational materials were created about the subject “Hydrogen Fuel Cells” because hydrogen is a “Clean” energy source producing only one product, water, during energy generation and was offered as an undergraduate lecture course.^{1,2} Then, a laboratory course was developed consisting of eight experiments relating to hydrogen fuel cell technology.^{3,4}

To further interest students, this lecture course was taught in a distance learning format using presentation slides, recorded lectures, discussion forums, exercises, and exams as pedagogic tools. The syllabus also included online lab experiment demonstrations with calculations and discussions. A New York State Energy Research and Development Authority (NYSERDA) grant helped expand the program into a “Rochester Regional Clean Energy Education Partnership”.

For the past seven years, Constellation Energy, an Exelon Company, Energy to Educate grant program provided funding to expand the program to K-12 High School teachers and students, and during the COVID-19 pandemic, was converted to K-12 online learning. The program covers the subjects: Global Warming; Clean Energy Sources; Hydrogen as a Fuel and an Energy Carrier; Fundamentals of Electrochemistry; Electricity Generation using Fuel Cells; Fuel Cell Construction; Hydrogen Properties, Storage, and Production; and Hydrogen Infrastructure. Online Zoom meetings were held demonstrating the Laboratory Experiments: (1) “Fuel Cell Construction”, (2) “Electricity Generation with Hydrogen/Oxygen Fuel Cells”, (3) “Measuring the Amount of Hydrogen Generated from Chemical Reactions and Parameters of Electricity Generated”, and (4) “Solar Electrolysis of Water”. High School Teacher participants received an RIT Certificate of Attendance and, after these Sessions, were assisted with incorporating these materials into their High School curriculum.

¹R. J. Press, K. S. V. Santhanam, M. J. Miri, A. V. Bailey, and G. A. Takacs, “Introduction to Hydrogen Technology”, John Wiley & Sons, Inc., Hoboken, New Jersey (2009).

²K. S. V. Santhanam, R. Press M. Miri, A. Bailey, and G. A. Takacs, “Introduction to Hydrogen Technology”, Second Edition, John Wiley & Sons, Inc., Hoboken, New Jersey (2018).

³K. S. V. Santhanam, G. A. Takacs, M. J. Miri, A. V. Bailey, T. D. Allston, and R. J. Press, “Clean Energy: Hydrogen/Fuel Cells Laboratory Manual”, World Scientific Publishing Co., Singapore (2016).

⁴A. Bailey, L. Andrews, A. Khot, L. Rubin, J. Young, T. D. Allston, and G. A. Takacs, “Hydrogen Storage Experiments for an Undergraduate Laboratory Course-Clean Energy: Hydrogen/Fuel Cells”, *J. Chem. Educ.* 92(4), 688-692 (2015).