

Title The role of hydrogen energy technologies in combating climate change: Is a ‘proton battery’ the answer?

Speaker Prof. John Andrews
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Place I²CNER hall, I²CNER Bldg.1, Ito campus, Kyushu University

Abstract

The possible role of hydrogen-energy technologies for storing renewable energy in a sustainable global strategy to tackle climate change and guarantee energy security will be proposed. A report, including a short video, on the successful demonstration at RMIT University last year of a portable and rechargeable power supply based on a ‘unitised regenerative fuel cell’ (URFC), as the culmination of a major Australian government-funded project, will be given. The latest advances in the next-generation technology to a URFC, in the form of a ‘proton battery’ – a reversible hydrogen fuel cell with an integrated carbon-based electrode in which protons are stored directly in porous carbons without formation of hydrogen gas – will then be presented. This novel system has the potential to compete with the lithium ion battery, overcoming the inherent disadvantages of hydrogen-based electrical energy storage systems of multiple components and low roundtrip efficiency. The ‘carbon H-park’ concept of using novel graphene or carbon-nitride materials for reversible electrochemical storage of hydrogen in a proton battery will be introduced. Such ‘reversible hydro-carbons’ may offer a solution to the very large scale storage of solar, wind and water energy that will be required in a truly sustainable and safe zero greenhouse emission future. Graphical simulations based on *ab initio* Molecular Dynamics and Ehrenfest Molecular Dynamics – hybrid quantum-mechanical and classical approaches to molecular-crystalline modelling – of the interaction between a proton and carbon atoms on graphene will be shown and compared. In conclusion, the exciting opportunities for research collaboration between RMIT University and I²CNER in a recently-started project funded by the Australian Renewable Energy Agency (ARENA) on a ‘proton flow reactor’ for producing a solid hydrogenated carbon-based material for large-scale electrical energy storage bulk export will be outlined.

About the Speaker

Professor John Andrews has a BA(Nat. Sci) degree, specialising in theoretical physics, and a MA degree from Cambridge University (Queens’ College), and a PhD from RMIT University, Melbourne, Australia. He has nearly 40 years’ experience in research in the sustainable energy field. He played a pioneering role in developing and deploying wind energy technologies for Australia, and initiated the first thorough investigation of the wind energy potential in Victoria while Policy Manager at the Victorian Solar Energy Council in 1984. His seminal book, *Living Better with Less* (Penguin, 1981), was one of the first works to articulate sustainable development in the Australian context. Since returning to academia in the mid 1990s he established the renewable-energy hydrogen research group in the School of Engineering at RMIT University, and has led four major sustainable energy R&D projects, including most recently the \$1.6 m RMIT URFC Demonstrator project on reversible fuel cells. He is the founder of RMIT’s successful Master of Engineering (Sustainable Energy) program, and Project Leader of the ARENA project: “A proton flow reactor system for electrical energy storage and bulk export of hydrogenated carbon-based material”.

Host: Professor Hiroshige Matsumoto

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