Hydrogen and fuel cell technology

Background & overview by Dr Sivakumar Pasupathi, University of the Western Cape

The high quality of life enjoyed in developed countries and the rapid development of China and India points towards a growing market and thereby opportunities for business. However, this means a huge increase in the energy requirements. Security of energy supply along with climatic changes and pollution are therefore seen as the two major concerns of the energy future and has been highlighted in the green paper on European strategy.

With the exhaustion of fossil resources and the increasing energy needs of our current and future civilization, the establishment of a sustainable energy future is necessary to ensure continued development and a balanced ecosystem. Sustainable development, where the resources are used sparingly and efficiently with environmental responsibility is a must to the long-term economic success of any organization or country.

The evolution of modern civilization points towards a hydrogen based energy system. Wood was used in the early days followed by coal, oil and natural gas. On closely looking at the energy evolution, one can see a decrease in the carbon content from wood to natural gas and an increase in the hydrogen content. The impending energy revolution therefore might be the hydrogen economy. Most of the countries consider hydrogen as a viable solution to address long-term energy security, environmental and economic concerns and there is a growing interest in a global paradigm shift from the current energy system to a hydrogen economy.

Hydrogen is a promising energy carrier whose adoption would represent a radical change in which energy is produced, distributed and consumed. As an energy carrier, hydrogen can also significantly reduce the problem of greenhouse gas emissions and atmospheric pollution, especially if it is produced using renewable energy. The potential demand for new products and services in a hydrogen economy suggests that one can benefit significantly in economic and social terms. The benefit can come not only from a transition within a country, but also through the establishment of new industries, thereby creating new jobs and income from exporting hydrogen energy related technology and services to the rest of the world. South Africa is ideally placed to benefit hugely from the impending hydrogen economy, thanks to

its vast resources, especially platinum group metals, because platinum as a catalyst is an integral part of the hydrogen technology.

A long-term (15-year) Hydrogen and Fuel Cell Technologies (HFCT) Research, Development, and Innovation (RDI) strategy was officially launched in September 2008 by the Department of Science and Technology (DST) in South Africa, termed as “Hydrogen South Africa (HySA)”. The overall vision of the HySA strategy is to bring about wealth creation through the initiation of new high tech industries based on minerals found on South African soil, especially platinum group metals (PGMs). The two main goals of the strategy are to capture 25% of the global demand for PGM in hydrogen energy technologies and to create new jobs in this area in South Africa.

The overall approach taken by DST has been to establish three HFCT competence centres (CoCs): HySA Systems (UWC), HySA Catalysis (UCT/Mintek), and HySA Infrastructure (NWU/CSIR). HySA Infrastructure mainly focus on various hydrogen production technologies (e.g. water electrolysis), hydrogen distribution, and hydrogen storage technologies (except solid state hydrogen storage). HySA Catalysis (UCT/Mintek) mainly focus on the development of fuel cell catalysts, membrane electrode assemblies (MEAs) for low temperature PEM fuel cells, and fuel processors. HySA Systems mainly focus on the development of MEAs for high temperature (> 120°C) PEM fuel cell stacks, hydrogen purifiers (Pd thimbles and membranes), solid state hydrogen storage and compressors (metal hydrides), batteries, and other electrical devices. HySA Systems has the overall responsibility for technology validation (e.g. validation of complete fuel cell systems) and system integration involving end-users (e.g., testing of integrated CHP-systems).

The CoCs have already established close collaborations with several research institutions and universities, both locally and abroad, including some companies and are geared towards achieving the goals of HySA. More information on HySA and the CoCs can be found at www.hydrogen.org.za.

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