

YORKSCIENCE

Hydrogen as an alternate energy source

Ultimately, it is the sun that is able to provide an unlimited supply of energy for our planet. If the sun's energy can be easily and cheaply converted to useful energy, then our lifestyle may continue to evolve towards that Utopia we all dream of. "All we need to do is to trap the sun's power and convert it to useable energy," believes York's Chemistry Department's Dr. A.B.P. Lever.

Energy research at York is focussed on basic and fundamental reactions that can convert the sun's energy to useable chemical energy. Hydrogen/Oxygen fuel cells to provide this needed energy conversion are emphasized in Dr. Lever's research in this critical field. Hydrogen, known to be the world's best fuel, is the lightest, cleanest and potentially most abundant fuel on earth. When combined with oxygen, it forms water and electrical power in fuel cells.

Research in Dr. Lever's laboratory deals with two aspects of the hydrogen economy problem. How do we get hydrogen and oxygen from water by using the sun's energy, and how do we burn hydrogen and oxygen efficiently in a fuel cell to generate electrical power and water?

The first problem utilizes a photocatalyst, a dyestuff, which is excited by absorption of energy from sunlight. This excited molecule must then transfer its energy to a water molecule, causing dissociation to hydrogen and oxygen, and regenerating the ground state dyestuff which is then free to absorb more energy from the sun, etc. Dr. Lever is studying a molecule, methyl viologen, which acts as a relay between the excited dyestuff and water. An electron from the excited dyestuff reduces methyl viologen; reduced methyl viologen then reacts readily with water, in the presence of a platinum catalyst, to generate hydrogen.

Bob Crutchley, a co-worker in

the Lever laboratory, has designed a ruthenium complex which acts as an excellent photocatalyst (dyestuff) and reduces methyl viologen with a yield of 80%. This catalytic efficiency is the best in the world. While this process is not itself economic, it provides the fundamental knowledge necessary in the economic system. Dr. Lever and his co-workers have also been studying electrocatalysts that are coated onto fuel cell electrodes in order to develop a more powerful fuel cell.

Additional alternate energy studies are being undertaken in conjunction with the University of Alberta. A dye coated on an electrode is being developed to produce H₂, O₂ and electricity when light is shined on this cell. A

group of chemicals called phthalocyanines have been shown to be useful both in the electro-catalytic and photocatalytic reactions, however more improvements are required. The first study of the reaction of methyl viologen with a phthalocyanine was reported by Dr. Lever's group. They discovered that low energy light, found at the earth's surface, was effective, in reducing methyl viologen. Dr. Lever working with Dr. David Scott, from the University of Toronto's mechanical engineering department, hope to develop fuel cells for commercial application in the near future.

An example of one potential application of hydrogen could be for running the GO train. An excess of power could be readily obtained from the Pickering

power station, east of Toronto, which could be then used during off-peak hours to electrolyse water to hydrogen and oxygen. A GO train with the three megawatt fuel cell could re-fuel with hydrogen at Pickering whenever necessary. This would provide cheap fuel, reduce our dependence upon foreign oil, and make transportation around Toronto more efficient and pleasant.

Indeed it is possible to fuel a suitably modified automobile with hydrogen. Canada has sufficient excess power which could be used to generate hydrogen gas from water. "A major political decision to go Hydrogen would need to be made if we are to follow this route," stated Dr. Lever.

Richard Dubinsky



Silvia Licoccia using a spectrofluorometer to measure the lifetime of a possible catalyst

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