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NSERC'S RESEARCH AND INDUSTRIAL COMMUNITY:

A GROWING FORCE OF DISCOVERY, PEOPLE AND INNOVATION SHAPING TOMORROW'S FUEL CELL AND HYDROGEN ECONOMY

As Canada's largest university research-funding agency, the Natural Sciences and Engineering Research Council of Canada (NSERC) supports the training of some 23,000 university students and postdoctoral fellows, funds the research efforts of more than 11,000 university professors, and stimulates university-business research and development (R&D) partnerships involving about 1,300 Canadian companies each year.

Natural Sciences and Engineering Research Council of Canada
Conseil de recherches en sciences naturelles et en génie du Canada
Canada

HERE IS A SAMPLING OF SUCCESSFUL NSERC-FUNDED PUBLIC-PRIVATE R&D PARTNERSHIPS:

Calgary power play scores with microtubular fuel cells

Researchers at the University of Calgary, under the guidance of chemistry professor Dr. Viola Birss, have delivered valuable new insights to the Alberta Research Council (ARC) about how to overcome power output limitations associated with ARC's microtubular solid oxide fuel cells (SOFCs).

Using a three-electrode test approach, the scientists determined that the ARC needs to thicken and improve the uniformity of the electrochemical catalytic material coating on the inner layer anode of the microtubular SOFCs. In contrast to two-electrode testing, which can measure only the power output of the entire fuel cell, the three-electrode methodology permits more complete testing of various power outputs at precise points along a microtubular SOFC's inner layer anode and outer layer cathode.

The three-year, NSERC-funded Collaborative Research and Development project was sponsored by the ARC and Advanced Measurements Inc. (AMI). For its part, AMI intends to incorporate the measurement techniques into software that is bundled with its fuel cell test stations.

Platinum catalysts: getting more from less

Scientists at the Institut national de la recherche scientifique in Varennes, Quebec, have invented a platinum (Pt) nanowire catalyst for polymer electrolyte membrane fuel cells (PEMFCs) that promises more power output per catalytic surface area of the precious metal, compared to conventional Pt catalyst structures.

Spearheaded by Dr. Jean-Pol Dodelet,holder of the NSERC-General Motors of Canada Industrial Research Chair in Electrocatalysis for PEMFCs, the invention addresses one of the key barriers to commercialization of PEMFCs – the comparatively high cost of Pt, a noble metal.

Dr. Dodelet's team is also developing non-noble metal (iron and cobalt) catalysts as cost-effective alternatives to Pt.

So far, the group has achieved an order of magnitude increase in the performance of the alternatives, although it expects further improvements of between one and two orders of magnitude will be necessary before these affordable catalysts are commercially practical.

New use for carbon dioxide: adding weight to hydrogen storage

At the University of New Brunswick (UNB), Dr. Sean McGrady and his team have adopted a new approach to creating light metal hydrides – chemically bonding hydrogen to aluminum. This represents a potential breakthrough in the challenging field of hydrogen storage.

Working under an NSERC Strategic Project Grant, in partnership with HSM Systems Inc., the UNB researchers have produced lab-scale aluminum hydrides that deliver as much as 10 per cent hydrogen by weight. That represents about twice the storage density of the current state of the art in metal hydrides, and exceeds the 2015 target for hydrogen density established by the U.S. Department of Energy.

Key to this development is the use of supercritical carbon dioxide (CO_2) which allows the aluminum metal to be charged with high concentrations of hydrogen at moderate temperatures. This ensures that damaging heat is removed quickly to avoid product degradation and optimizes storage density. Another advantage of supercritical CO_2 over conventional methods is that the aluminum hydrides can be produced in a matter of hours instead days.

FOR CANADIAN BUSINESSES, THE ADVANTAGES OF PARTNERING WITH NSERC AND UNIVERSITY RESEARCHERS ARE MULTI-FOLD. NSERC'S RESEARCH PARTNERSHIP INITIATIVES HELP COMPANIES:

- OBTAIN EARLY ACCESS TO STATE-OF-THE-ART DEVELOPMENTS;
- REDUCE UP-FRONT COSTS AND RISKS;
- ASSESS THE SUITABILITY OF POTENTIAL EMPLOYEES; AND
- BENEFIT FROM UNIVERSITY FACILITIES AND EQUIPMENT.

"PARTNERSHIPS WITH NSERC ALLOW US TO SHARE THE RISKS AND OPTIMIZE THE RESULTS OF COLLABORATING WITH UNIVERSITIES. AND THAT'S EXTREMELY IMPORTANT BECAUSE WE RELY ON UNIVERSITY RESEARCHERS TO PERFORM THE LONGER-TERM, EXPLORATORY RESEARCH THAT CAN LEAD TO GAME-CHANGING, BREAKTHROUGH TECHNOLOGIES."

Dr. Charles Stone
Vice-President, Research and Development,
Ballard Power Systems Inc.

Dr. Charles Stone is no stranger to NSERC. His career at Ballard Advanced Materials was launched in 1990 with the aid of an NSERC Industrial Research Fellowship (IRF), a salary stipend for postdoctoral fellows who join Canadian businesses.

Dr. Stone was actually one of four Industrial Research Fellows enlisted by Ballard's materials science subsidiary. In fact, the president of that unit, Dr. Alfred Steck, was also an NSERC Industrial Research Fellow.

"When I joined, Ballard Advanced Materials was a relatively small group and they were very cash-strapped," recalls Dr. Stone. "Yet because of the nature of the business (engineering complex components for fuel cell membranes), they needed highly qualified people with considerable research training, and that's why the IRFs were so important."

"Thanks to the great start, made possible by NSERC," Stone notes, "I have risen through the ranks at Ballard to lead the R&D function. If the need and opportunity arise again, I wouldn't hesitate to hire another NSERC-funded fellow."

NSERC'S FUEL CELL AND HYDROGEN PARTNERS – 2006

INDUSTRY // 3M Canada - Angstrom Power Inc. - Ballard Power Systems Inc. - Canadian Council on Electrotechnologies - DuPont Canada - EFC Corporation - Fuel Cell Technologies, Ltd. - General Motors of Canada Limited - H2S Technologies - HSM Systems Inc. - Hydrogenics Corporation - Hydro-Québec - Commercial Alcohols Inc. - Manitoba Hydro - Membrane Reactor Technologies Ltd. - Northwest Mettech Corp. - Palcan Power Systems Inc. - Pure Energy Visions Corporation - SiM Composites - StART (Strategic and Renewable Technologies) Corporation - Tekion, Inc. - Vaperma Inc. - Versa Power Systems, Inc.

OTHERS // Alberta Research Council - BIOCAP Canada Foundation - National Research Council Canada

In the fuel cell and hydrogen arena, NSERC has sponsored cutting-edge research for over two decades. During that time, the level of activity has intensified dramatically – from a mere handful of projects in the early 1980s and 1990s, to more than 150 grants and scholarships in 2006.

Since 2002, NSERC's annual support has more than doubled from about $2.9 million to over $7 million. In 2006, that investment attracted over $1.6 million in cash and in-kind contributions from some 20 fuel cell and hydrogen industry partners.

NSERC supports fuel cell and hydrogen advances through its Discovery Grants for basic research, Research Partnerships Programs' grants for project research (involving companies) and knowledge transfer, and scholarships and fellowships for advanced training.

In addition, NSERC recently identified fuel cells and hydrogen storage as priority topics for research funding through 2011. The new priorities fall under the Sustainable Energy Systems target area of NSERC's Strategic Project Grants program, which supports public-private R&D partnerships.

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