

Fuelling Efficiency

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Building a better fuel cell will lead to energy and cost savings, as well as massive reductions in hydrocarbon emissions.

Fuel cell technology promises a cleaner, brighter future for energy consumers, and Professor Mina Hoorfar's research is pushing fuel cell efficiency to new heights.

Worldwide, energy efficiency is a vital issue in the quest for environmental and economic sustainability. The need to manage and conserve energy has led to the development of advanced technology such as the proton exchange membrane (PEM) fuel cell, which has drawn much attention in the last decade as a high-efficiency and low-emission source of energy. PEM fuel cells produce electricity by oxidation of hydrogen and reduction of oxygen. The only waste product is water.

"Despite these inherent benefits, the performance and cost of the PEM fuel cells must be improved significantly before they can constitute a viable market," explains Hoorfar, who is in the process of establishing a Fuel Cell Research Laboratory that will focus on advancing fuel cell technology.

A key issue surrounding PEM fuel cells is water management—a finicky balance that is difficult to achieve. The polymer membrane of the fuel cells needs to be well hydrated to maintain proton conductivity. However, too much water, even by the slightest amount, can cause the PEM to be unproductive.

"Excessive water vapor condensation, due to a long operation or large output current, forms water droplets that block the access of the reactant gas to the reaction site," says Hoorfar. "This reaction site is the typical origin of the limiting current for the PEM fuel cells."

Hoorfar seeks to solve this problem by improving water management—intricate work that involves studying individual droplet formation and water transport in the internal network of the fuel cell.

Her research is developing novel theoretical and experimental methodologies for measuring the surface properties of different components of the PEM fuel cell. The results of this research will provide a better understanding of liquid water transport and, ultimately, better water management in PEM fuel cells.

These results could have incredible impact. According to estimates by Natural Resources Canada, if natural gas is used to produce hydrogen for PEM fuel cells and Canada's 17 million vehicles were powered by PEM fuel cells, emissions would decrease by 71 million tons per year.

Building a better fuel cell will lead to energy and cost savings, as well as massive reductions in hydrocarbon emissions. Hoorfar's research is more than advancing fuel cell science—it's engineering a better future.

