Powerful magnets help scientists create new materials for use in low-carbon energy

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(PhysOrg.com) -- West Midlands scientists have created and studied new materials set to make low-carbon energy technologies like fuel cells cheaper and more efficient to run.

Collaborative research efforts involving the University of Warwick and University of Birmingham have paved the way for improved efficiency in fuel cells to be used in homes, buildings, construction sites, war zones or anywhere where isolated forms of power generation are required.

Many major companies use fuel cell systems and in the UK, for example, some are even looking at trialling this technology as a replacement for gas boilers.

Fuel cells convert hydrogen and oxygen into water and in the process produce electricity, making them an attractive form of low-carbon energy.

However, they operate at very high temperatures and take a long time to reach and stabilize at these operational temperatures.

By introducing the new materials - known as rare-earth apatites - into their design, the working temperatures and the time needed to reach them will be reduced, improving operational aspects of the device and making it more efficient.

Lower operational temperature also means that they will last longer and

be cheaper to produce.

John Hanna, Principal Research Fellow in the Department of Physics at the University of Warwick, said: ”Fuel cells typically operate at temperatures of around 800 - 1,000 degrees, and you cannot just flick a switch and get power from them immediately.

“However, the conduction properties of these new materials means that these operational temperatures can be reduced, meaning that higher efficiencies and cost savings can be achieved.

“These clear benefits will strengthen what is already an environmentally friendly and easily positioned energy source.”

The facilities and equipment used for the research have been funded by Birmingham Science City as part of the Science City Research Alliance Energy Efficiency (AM1) Project.

Part of the research was carried out using Nuclear Magnetic Resonance (NMR) instruments at the University of Warwick’s Centre for Magnetic Resonance.

This facility is home to the UK’s largest solid-state NMR magnet laboratory.

This technique allows researchers to gain a detailed understanding of the structure and motion of molecules and atoms within material frameworks, which will help in the design and creation of new ‘energy materials’ for fuel cell, hydrogen storage and battery technologies.

The facility also conducts research into new drug and pharmaceutical development and can even provide insights into diseases such as Alzheimer's.

More information: The research is published in the journal *Angewandte Chemie* Oxygen Defects and Novel Transport Mechanisms in Apatite Ionic Conductors: Combined 17O NMR and Modeling Studies. onlinelibrary.wiley.com/doi/10 … e.201102064/abstract

Provided by University of Warwick