

SCIENTISTS IN QATAR AND IRELAND DISCOVER MYSTERY BEHIND NEW SOLAR ENERGY HARVESTING MATERIAL

Doha, Qatar, 07 June 2015: Qatar's ambitious plans to diversify its energy supplies have taken a huge leap forward thanks to ground-breaking new research into solar power.

The Qatar Environment and Energy Research Institute (QEERI), a Qatar Foundation for Education, Science and Community Development (QF) national research institute, has discovered the chemical secrets of a new material that could make the generation of solar energy far more economical, and finally unleash the potential of this abundant renewable resource. In turn, this exciting breakthrough is ultimately expected to contribute to QF's mission of building Qatar's innovation and technology capacity, ensuring the sustainable development of energy that will benefit this country, as well as the rest of the world.

According to scientific experts, the natural power of the sun supplies the Gulf state with the annual equivalent of 1.5 million barrels of oil per square kilometre.

However, much of this goes to waste. The high cost of harvesting the latent energy has made it an unattractive investment for 'traditional' energy companies, and it has become a major obstacle to Qatar in realising its ambition of generating a fifth of its energy needs from renewable resources by 2024.

Now QEERI, which has taken a leading role in energy and water security research in the region, may well have come up with a solution that will lead to less reliance on oil and gas in the future.

Explaining the importance of conducting solar energy research in Qatar, Dr Mohammed Khaleel, QEERI's Executive Director, said: "This country's rapid population and economic growth has led to ever-increasing demands for electricity. Without steps to secure additional sustainable energy sources, and to reduce consumption, the economy and the environment will be adversely affected within the next few years. For this reason we are continuing to focus our efforts on harnessing the power of the sun – Qatar's most abundant natural resource – as we

develop new energy solutions for this country and the region as part of our continued support of the Qatar National Vision 2030.”

The research, which has been conducted in tandem with AMBER, a research centre funded by Science Foundation Ireland (SFI) and jointly hosted by Ireland’s Trinity College Dublin (TCD) and the Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN), has looked specifically at a newly discovered material called perovskite.

Perovskite, which is crystal-like in form, has excited the scientific world since its discovery in 2012, due to the fact that it is a cheaper, and potentially more effective, alternative to silicon, one of the traditional materials used in solar cells. In just three years the mineral has made progress at unprecedented speeds, with the latest research suggesting that perovskite cells are now capable of efficiencies greater than 20 per cent, a milestone which took silicon several decades to achieve.

This impressive progress has captured the attention of the global scientific community, which is already predicting that perovskite cells can soon overtake silicon cells in their efficiency levels.

However, perovskite’s seemingly unstoppable rise has been cut short due to the material’s natural instability. Even just to function, perovskites must be held in an inert atmosphere, exposed to almost no oxygen, low humidity levels, and no temperature variations.

QEERI and AMBER’s research has revealed important secrets about how the mineral functions and operates. Up until now, researchers have remained puzzled as to how perovskite is able to store and capture solar energy, with scientific opinion divided as to precisely what chemical process occurs naturally inside the material after it has been exposed to the solar rays.

Finally the mystery has been solved, with the QEERI and AMBER research revealing how the inorganic crystals inside perovskite are able to alter in structure following exposure to sunlight, allowing them to trap energy internally.

It is now hoped that this finding, which was recently published in the prestigious scientific journal ‘Nature Communications’, will help the scientific community’s understanding of perovskite and bolster global research efforts to address the mineral’s innate stability issue.

The research, which took years to complete, was done by using advanced computer modelling and simulation tools, a process that involves creating and analysing a prototype of the material to predict its performance in the real world, and focusing specifically on the electronic properties of these materials.

Excited about this breakthrough, Dr Sabre Kais, Director of the Theory, Modelling, and Simulation Group at QEERI, said: “This finding is the result of a lot of hard work. About two years ago, we started weekly seminars to discuss and understand the properties of this class of materials. The discovery happened as Dr Fadwa El-Mellouhi, Dr Nouar Tabet, and Dr Fahhad Alharbi, from QEERI and Dr Carlo Motta, from AMBER, presented and analysed the results of their study during one of our seminars.”

Speaking about the future of perovskite, AMBER’s Professor Sanvito, who is also Professor of Condensed Matter Theory at Trinity’s College of Physics in Dublin, Ireland, said: “Every hour, the sun releases on Earth as much energy as that used by the entire planet in one year. Harvesting such an enormous amount of energy in an efficient and cost-effective way would mean abundant green energy for the entire human race. Developing and improving our knowledge of solar energy harvesting is crucial. This is an exciting discovery. Now that we understand how these new materials work, we can design new compounds to use for solar energy harvesting at cheaper costs than silicon solar cells. A further advantage is that the materials can be grown chemically without expensive high-temperature processes.”

So where does QEERI’s and AMBER’s research go from here? They were recently awarded a grant to continue their research by the Qatar National Research Fund (QNRF), a funding agency established by Qatar Foundation that aims to foster original, competitively selected engineering and technology, physical and life sciences, medicine, humanities, social sciences and the arts research projects.

Dr Fadwa El-Mellouhi, Senior Scientist at QEERI and Co-Author, said: “We are thankful to QNRF for funding our research activities. This grant will involve both modelling to be completed by our team at QEERI and Professor Sanvito’s group, as well as the experimental activity to be completed by our Principal Investigators (PIs) and other AMBER/CRANN Investigators. The funding will allow us to expand our investigations using state-of-the-art techniques and data analytics.”

The full paper can be viewed at:

www.nature.com/ncomms/2015/150427/ncomms8026/abs/ncomms8026.html

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About Qatar Environment and Energy Research Institute (QEERI)

Qatar Environment and Energy Research Institute (QEERI) is a member of Qatar Foundation for Education, Science and Community Development and is part of Hamad Bin Khalifa University. As a national research institute, QEERI plays a leading role addressing the national Energy and Water Security Grand Challenges through Research and Development (R&D). Aligned with the Qatar National Vision 2030's strategy of transforming the State into a diverse and sustainable knowledge-based economy, QEERI's water R&D program is developing innovative technologies in water desalination and treatment; water quality and reuse; aquifer recharge; and climate change and atmospheric science. QEERI's energy R&D focuses on Solar Photovoltaics (PV), energy storage and smart grids. For more information, please visit www.qeeri.org.qa

About AMBER

AMBER (Advanced Materials and BioEngineering Research) is a Science Foundation Ireland funded centre which provides a partnership between leading researchers in material science and industry to develop new materials and devices for a range of sectors, particularly the ICT, medical devices and industrial technology sectors. The centre is hosted in Trinity College Dublin, working in collaboration with CRANN (Centre for Research on Adaptive Nanostructures and Nanodevices), the Trinity Centre for Bioengineering and with University College Cork and the Royal College of Surgeons of Ireland.

Qatar Foundation – Unlocking Human Potential

Qatar Foundation for Education, Science, and Community Development (QF) is a private, non-profit organisation that is supporting Qatar on its journey from carbon economy to knowledge economy by unlocking human potential, for the benefit of not only Qatar, but the world. Qatar Foundation was co-founded in 1995 by His Highness Sheikh Hamad bin Khalifa Al Thani, the Father Amir, and Chairperson Her Highness Sheikha Moza bint Nasser. QF's work encompasses education, research and community development. World-class universities are brought to Qatar to help create an education sector in which young people can develop the attitudes and skills required for a knowledge economy. At the same time, QF builds Qatar's innovation and technology capacity by developing and commercialising solutions through key sciences. The Foundation also works to foster a progressive society while enhancing cultural life, protecting Qatar's heritage and addressing immediate social needs in the community.