Perovskite power lights up solar energy market

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New research could help to revolutionalise the solar energy market.

(Phys.org) —New research from scientists at the University will help in the development of perovskite solar cells that have the potential to radically revolutionise the solar energy market.

Since being unveiled last year, researchers around the globe have been excited by the prospect of perovskite solar cells. These cells are cheap and easy to produce, highly efficient at converting the sun's rays to electricity and therefore, combined, have strong commercial potential.

Recently published research from the Materials Design Group within our Department of Chemistry now explains how and why these cells work so well which will help in the future development of solar technologies.

Professor Aron Walsh, who leads the Materials Design Group, explains: "Hybrid perovskites are an exciting development for solar energy

research. The field is rapidly progressing, but the devices have been developing faster than our fundamental understanding of how they work."

Perovskites combine organic and inorganic chemistry to mimic a crystal structure found in a natural mineral, 'perovskite', discovered in Russia in 1839. Using the UK's largest supercomputer, the researchers at Bath have been able to model the chemical and physical properties of these materials.

The first publication, led by Federico Brivio as part of Bath's DESTINY Initial Training Network, in *Physical Review B* details how the quantum mechanical interaction between electrons and their rapid motion in these materials allows them to absorb sunlight so strongly.

The second, led by Dr Jarvist Frost as part of an EPSRC energy materials consortium, in *Nano Letters*, reveals the mechanisms by which the materials can convert sunlight to electricity. This is distinct from previous generations of solar cells due to the role of organic molecules not present in natural perovskite minerals.

Commentators suggest that if we could capture approximately 1 per cent of the sunlight falling on the UK and turn it into electricity, we would meet current energy demands. With recent studies suggesting that new solar cells using perovskites could create efficiencies pushing 20 per cent, such technologies could elevate solar power in the UK at a cost that could compete with fossil fuels.

Such high efficiencies would also make perovskites competitive with existing commercial silicon solar cells while at the same time being much cheaper to produce in high volumes. Suitable for incorporating into roofing materials and glass panels, new solar technologies could soon be a common feature in city architecture.

Professor Walsh added: "Our materials simulations are complementing experimental characterisation in our Department, by Dr Petra Cameron and Professor Laurie Peter, which is allowing us to bridge from the fundamental to applied science."

More information: "Atomistic Origins of High-Performance in Hybrid Halide Perovskite Solar Cells." Jarvist M. Frost, Keith T. Butler, Federico Brivio, Christopher H. Hendon, Mark van Schilfgaarde, and Aron Walsh. *Nano Letters* Article ASAP. DOI: 10.1021/nl500390f

"Relativistic quasiparticle self-consistent electronic structure of hybrid halide perovskite photovoltaic absorbers." Federico Brivio, Keith T. Butler, Aron Walsh, and Mark van Schilfgaarde, *Phys. Rev. B* 89, 155204 – Published 21 April 2014. journals.aps.org/prb/abstract/ … 3/PhysRevB.89.155204

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