Perovskite solar cell reaches record efficiency

8 January 2015, by Bob Yirka

A team of researchers with Korea Research Institute of Chemical Technology and Sungkyunkwan University has developed a new formula for mixing perovskite structures that has led to the team achieving a new record level of efficiency in solar cells made from them. In their paper published in the journal *Nature*, the team describes how they came up with the new formula and what it might mean for the future of solar cell technology.

Solar cells have come down significantly in price over the past decade, but not enough to cause most people to rush out and buy them for use as an alternative energy source. For that reason, research goes on—scientists have continued to try to make silicon based cells more efficient, but have begun to run out of ideas. That has led to a search for other materials, one of which are perovskite structures (materials with the same structure as calcium titanium oxide)—they offer good power output from low cost materials and can be used in a simpler processes. Over just the past half decade, scientists have increased the efficiency of cells made using them from just 3.8 percent back in 2009, to the new current record set by the team in Korea of 17.9 percent.

The team reached this new level by blending methylammounium lead bromide with formamidinium lead iodide just right—achieving the high efficiency came about by experimenting with the ratios of the two ingredients. They found that an 85:15 mixture provided the best results. The team also reported that cells made using their mixture could be produced via a printing process, which would hopefully mean even lower production costs.

There are still problems to be addressed of course—perovskite based materials are water soluble which is a serious concern for solar cells that will be exposed to the elements. Also, there is the problem of scaling, the cells being tested were just $0.1cm^2$. And then there is the well known issue of hysteresis, where the material sometimes appears to change when first exposed to sunlight, causing a drop in efficiency. The team in Korea plans to continue their work with perovskite based materials hoping to overcome these issues and perhaps increase the efficiency even more.

More information: Compositional engineering of perovskite materials for high-performance solar cells, *Nature* (2015) DOI: 10.1038/nature14133

Abstract
Of the many materials and methodologies aimed at producing low-cost, efficient photovoltaic cells, inorganic–organic lead halide perovskite materials appear particularly promising for next-generation solar devices owing to their high power conversion efficiency. The highest efficiencies reported for perovskite solar cells so far have been obtained mainly with methylammonium lead halide materials. Here we combine the promising—owing to its comparatively narrow bandgap—but relatively unstable formamidinium lead iodide (FAPbI3) with methylammonium lead bromide (MAPbBr3) as the

light-harvesting unit in a bilayer solar-cell architecture13. We investigated phase stability, morphology of the perovskite layer, hysteresis in current–voltage characteristics, and overall performance as a function of chemical composition. Our results show that incorporation of $MAPbBr_3$ into $FAPbI_3$ stabilizes the perovskite phase of $FAPbI_3$ and improves the power conversion efficiency of the solar cell to more than 18 per cent under a standard illumination of 100 milliwatts per square centimetre. These findings further emphasize the versatility and performance potential of inorganic–organic lead halide perovskite materials for photovoltaic applications.

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