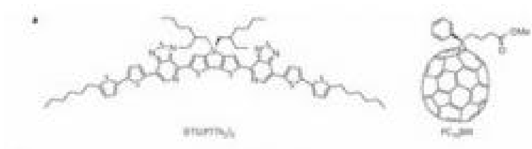
USC team develops promising polymer for solar cells

November 7 2011, by Bob Yirka



Molecular structures of DTS(PTTh2)2 and PC70BM. Image credit: *Nature Materials* (2011) doi:10.1038/nmat3160

(PhysOrg.com) -- Currently, most solar cells are based on silicon which for the most part, necessitates a rigid structure. This isn't always ideal as some applications would benefit by material that is more bendable. Also, because of the way silicon solar based cells are made, they tend to cost more than a lot of people are willing to pay. If a way could be found to mass produce solar cells very cheaply, its likely solar cells would be installed in far more places and costs for energy would go down.

One way to do this, researchers believe, is to create a polymer based material that could be used instead of silicon. Such material would cost less to produce and have sufficient bendiness that it could be printed onto bendable surfaces in much the same way newspapers are mass printed, i.e. via giant rollers. Up to now though, figuring out how to create such a polymer that is as efficient at converting sunlight into energy as silicon-based cells, hasn't really worked out.

Now though, a team working out of USC, headed by Alan Heeger, who along with Guillermo Bazan won the Nobel Prize in Physics back in 2000 for groundbreaking work they did on polymer cells, believe they have made another breakthrough. In their paper, published in *Nature Materials*, they say they've figured out a way to use an organic material with a low molecular weight (small molecule) to produce a solar cell that is every bit as efficient as current silicon technology.

The small molecule technology came about as the result of work done by Bazan, who used theory and lots of trial and error to produce just the right material; one that could, unlike many others that had been tried, be formed into a layer that could be applied to other materials. Heeger then took the lead in applying the new material in a solar cell. The end result the team says, is a solar cell capable of matching the 6.7% energy efficiency of silicon cells. And not only that, they believe with some tweaking, they can get it to 9%.

Unfortunately, there is a dark cloud looming ahead, and that is because the team isn't sure just yet if the new material will work as designed once it's ramped up to commercial size. In the past, when polymers have been sized up, their efficiencies went down.

More information: Solution-processed small-molecule solar cells with 6.7% efficiency, *Nature Materials* (2011) doi:10.1038/nmat3160

Abstract
Organic photovoltaic devices that can be fabricated by simple processing techniques are under intense investigation in academic and industrial laboratories because of their potential to enable mass production of flexible and cost-effective devices1, 2. Most of the attention has been focused on solution-processed polymer bulk-heterojunction (BHJ) solar cells3, 4, 5, 6, 7. A combination of polymer design, morphology control, structural insight and device engineering has led to power conversion

efficiencies (PCEs) reaching the 6–8% range for conjugated polymer/fullerene blends8, 9. Solution-processed small-molecule BHJ (SM BHJ) solar cells have received less attention, and their efficiencies have remained below those of their polymeric counterparts10. Here, we report efficient solution-processed SM BHJ solar cells based on a new molecular donor, DTS(PTTh2)2. A record PCE of 6.7% under AM 1.5 G irradiation (100 mW cm−2) is achieved for small-molecule BHJ devices from DTS(PTTh2)2:PC70BM (donor to acceptor ratio of 7:3). This high efficiency was obtained by using remarkably small percentages of solvent additive (0.25% v/v of 1,8-diiodooctane, DIO) during the film-forming process, which leads to reduced domain sizes in the BHJ layer. These results provide important progress for solution-processed organic photovoltaics and demonstrate that solar cells fabricated from small donor molecules can compete with their polymeric counterparts.