Solar-powered EVs More Possible Than Ever, Thanks to TMDs & Graphene

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The race is on to build the solar-powered Evs of the future, and it looks like graphene and TMDs could get the ball rolling.

The idea of EVs powered by on-board solar panels has been gathering steam, but obstacles abound. It will take the right combo of efficiency, durability, flexibility, weight, and cost to make the idea stick. That may be in the cards. A team of PV researchers based at Stanford University has come up with a new formula that could turn the dream of onboard solar power for EVs a reality.

Here Comes A New Solar Miracle Material

The pages of CleanTechnica are filled with promising new solar materials, such as the 2-D form of carbon known as graphene. Also making the list is perovksite, a class of synthetic crystalline materials with unique optical qualities.

Another class of materials called transition metal dichalcogenides surfaced around 2010. They first dipped a toe into the CleanTechnica radar back in 2013. In 2014 they popped up again, in relation to molybdenum diselenide. Another sighting appeared in 2019, in a project that involved harvesting solar energy with a “bionic leaf” device. That was the end of that until now, so we have some catching up to do.

As noted by the authors of a 2015 study of transition metal dichalcogenides published in the journal Nano Convergence, TMDs “exhibit unique electrical, optical, and mechanical properties.”

“Layered 2D nanostructures with atomic scale thicknesses may exhibit peculiar and fascinating properties in contrast with those of their bulk parent compounds. Both the experimental and theoretical results have shown that 2D semiconductors have exceptional properties that can result in novel and important breakthroughs in the field of nanomaterials and nanodevices,” the authors add.

Specifically, TMDs combine a transition metal with sulfur, selenium, or tellurium. For those of you keeping score at home, the latter three elements belong to the chalcogen group on the Periodic Table, and transition metal refers to the middle block of the Periodic Table.

TMDs For New Solar Super-Material For EVs, Eventually

That brings us to the new Stanford TMD research. As indicated by their 2-D nature, TMDs with a high solar conversion efficiency could fulfill part of the solar-powered EV formula.

A Stanford press release about the new study cites co-lead author on the study Koosha Nassiri Nazif, a Stanford doctoral scholar in electrical engineering at Stanford, who hints at the prospect of a TMD-cladded EV.

“Imagine an autonomous drone that powers itself with a solar array atop its wing that is 15 times thinner than a piece of paper. That is the promise of TMDs.”

Senior author on the study Krishna Saraswat emphasized that any solar material that seeks to dethrone silicon needs to take lifecycle environmental impacts into consideration.

“Silicon makes up 95 percent of the solar market today, but it’s far from perfect. We need new materials that are light, bendable and, frankly, more eco-friendly,” he said.

As for conversion efficiency, that’s where things get sticky.

“While TMDs hold great promise, research experiments to date have struggled to turn more than 2 percent of the sunlight they absorb into electricity. For silicon solar panels, that number is closing in on 30 percent. To be used widely, TMDs will have to close that gap,” Stanford explains.

The Graphene Solution For Solar Power On Wheels

In the field of solar conversion efficiency, 2% is really lame. That’s where graphene enters the picture. For those of you new to the topic, graphene is a 2-D form of carbon. It was discovered in 2004 when researchers peeled a nanoscale layer of carbon atoms from a chunk of graphite, using sticky tape.

To make their new solar cell, the Stanford researchers layered the TMD tungsten diselenide with graphene, and added a flexible polymer layer to both sides. They also added an extra coating to improve light absorbtion.

That’s not as easy as it sounds. Co-lead author Alwin Daus steered the process of affixing the micron-scale flexible substrate to the TMD sandwich. It was a technically challenging step but the result was worth the effort: a new prototype TMD solar cell about as thick as a thin plastic bag with 5.1% solar conversion efficiency.

The 5.1% mark is a high bar for TMD technology, but it’s still peanuts compared to other solar cells. However, the study concludes that additional tweaks will bring the new solar cell close to 27%, which puts the technology squarely in the big leagues.

Stanford also points out that the new prototype is already competitive with other thin film solar cells, going by the output of electrical power compared to weight.

“The prototype produced 4.4 watts per gram, a figure competitive with other current-day thin-film solar cells, including other experimental prototypes,” Stanford explains, adding that it “realized a 100-times greater power-to-weight ratio of any TMDs yet developed.”

Apparently you ain’t seen nothing yet, because the researchers calculate that the practical limit of their TMD formula is 46 watts per gram.

Next Steps To A Solar-Powered Car

For all the juicy details, look up the study “High-specific-power flexible transition metal dichalcogenide solar cells” in the journal Nature.

In the meantime, some EV owners are not waiting around. One Tesla owner made waves last spring by modding out his EV with conventional solar panels, though the results were somewhat less than aesthetically pleasing.

EV manufacturers are also trying to solve the on-board solar formula. That’s a tough nut to crack with conventional solar technology, considering that excess weight will interfere with battery range. However, back in 2011 the firm eNow zeroed in on the idea of retrofitting pickup trucks and other light duty vehicles with solar panels for auxiliary use. Since then, they have expanded into buses and refrigeration trailers among other areas.

In 2020 the startup Lightyear claimed that the solar panels planned for its inaugural Lightyear One EVs could provide for up to 70-90% of the car’s mileage, with a technology assist from the firm Royal DSM.

If that sounds expensive, it is — for now. As reported by CleanTechnica last month, the project is on track with the firm Valmet Automotive. The Lightyear One will roll you for a cool $170,000 if you want to be the first on your block, but wait until 2024 or 2025, and you can get the a shorter-range version dubbed Lightyear Two for $33,000.

Toyota has also been experimenting with on-board solar power for EVs, but that’s just the tip of a very large iceberg of EV makers and solar stakeholders that are not waiting around for TMDs. Our friends over at Industrial IT have just issued a new 7-year report on the global market for “crystalline solar powered cars.” Among the companies featured in the report are

Daimler AG, Ford, Toyota, Volkswagen AG, Panasonic, AB Volvo, BYD, Nissan, Trina Solar, Jinko Solar, and of course Tesla.

Read the original article on CleanTechnica.