American Chemical Society AMA: Hi! I am Amanda Morris, an Assistant Professor of Energy Chemistry at Virginia Tech. Ask me anything about how to make solar energy competitive!

AmerChemSocietyAMA [1] and r/Science AMAs[1]

[1]Affiliation not available

April 17, 2023

the WINNOWER

REDDIT

American Chemical Society AMA: Hi! I am Amanda Morris, an Assistant Professor of Energy Chemistry at Virginia Tech. Ask me anything about how to make solar energy competitive!

AMERCHEMSOCIETYAMA R/SCIENCE

[removed]

CORRESPONDENCE:

DATE RECEIVED:
November 02, 2016

DOI:
10.15200/winn.147800.04664

ARCHIVED:
November 01, 2016

CITATION:
AmerChemSocietyAMA , r/Science , American Chemical Society AMA: Hi! I am Amanda Morris, an Assistant Professor of Energy Chemistry at Virginia Tech. Ask me anything about how to make solar energy competitive!, *The Winnower* 3:e147800.04664 , 2016 , DOI: 10.15200/winn.147800.04664

Hi, hope this still makes it. I have recently turned my entire office building into a solar farm, I run almost 100% on solar during the "power hours" but I don't store. The reason being is because the price of solar panels has gone down and output up gradually each year.... but storage... storage is another thing, they are expensive, somewhat cost prohibited (my saving will never pay for them over their life) and just a bad all around.

What is being done in this field, I see solar as what all the cool kids are doing now a days, but storage isn't keeping up. Thoughts?

Likalarapuz

Battery technology is a huge field with many people working on solutions! With the announcement of Tesla's home battery system, that was a first step in what will be a long run of battery technology enhancements. I, personally, know of many start-up companies that are working to bring new technology to the market. The Department of Energy has also made huge investments in this area (http://www.jcesr.org/).

That said, you are completely right options now are too expensive (and quite honestly too large - who has the space for those things?). I am in the same boat as you hoping for and working hard for better solutions!

Cursory reading indicates that current solar cells operate at 15 to 22 percent efficiency, and degrade up to 35 percent over their expected lifetime, meaning that they will eventually have to be replaced.

Disregarding the initial upfront investment, and arguable financial break-even analysis, I'd like to ask about the life-cycle of solar cells. What happens to cells that have degraded to the point of uselessness? Can cells be rejuvenated or refurbished, or can they be recycled in any useful fashion? If not, what are the financial and environmental impacts to safely disposing of them?

Thanks!

Milspec1974

Great question! It is true that solar cells will eventually need replacing (although lifespans can be up to 40 years! [typically 20-30]). So, what do we do with them after? Similar to electronics certain components can be recycled. Indeed, First Solar offers recycling for all of their PV systems (http://www.firstsolar.com/en/Technologies-and-Capabilities/Recycling-Services)!

Hey I attend Virginia Tech as well, and was wondering how I could get involved with any potential research that you are doing involving solar energy or renewable energy in general. I am currently studying environmental science and chemistry here at virginia tech, so if you know of the best route to take to get myself involved with your research please let me know. Go hokies!

Eman848

Go HOKIES! Look me up at the chemistry department and send me an email. Let's see what we can come up with to get you involved!

I've been holding off on buying a solar system for the house because of a fairly high confidence that solar technology will become significantly more efficient and cost effective. Do you believe we have reached diminishing returns on solar panels yet, or are there still near to medium time span technologies working their way to market?

nate

The best investment point varies dramatically across the country. As epiclike points out, tax incentives can be huge. Location is also key in terms of amount of sunny days per year. There are great calculators out there to determine what incentives and prices you would get in your area. In the past I have used this calculator - http://www.solar-estimate.org/

How quickly do the returns on solar generated electricity reduce as you move north, and have to start dealing with conditions such as deep snow and weaker winter sun?

khendron

It turns out that solar can have a major impact even in locations where it is not so sunny. Take Germany for example. They get about 7% of their electricity from solar (and aim for 80% by 2020) despite getting the sun-equivalent of Alaska.

That's not to say your return could be greater in a sunnier location. But at the moment local tax incentives actually play a bigger role. To look at your location, try this calculator - http://www.solar-estimate.org/.

Are the new glass solar panel roof tiles introduced by Tesla/Solar City as exciting as I think they are?

BigAstra

Love the comments below!

GunpointFarts is absolutely right! Indeed, Dow chemical had a solar tile component to their business for many years. Unfortunately, they cut the program because it wasn't cost effective.

There are many challenges here, but ultimately the idea is great in terms of aesthetics. However, if energy generation is your goal, as was pointed out below - traditional solar panels can do it now!

Which do you think is a bigger hurdle for solar: the efficiency and cost of the technology or legislation regarding its use?

Edit: to clarify, I'm curious if more progress could be made on a global scale by improving the technology, or by focusing on better legislation, specifically in countries whose governments are not fully supportive of solar. To word it another way: Are certain countries' policies slowing the growth of the industry globally, or is industry growth limited by the technology itself?

VolatileSolution

Niemand72 is absolutely spot on. For the current price of solar installations to come down, this will have to be in the balance of system costs. Modules are already quite low. So, technology advancement in terms of the solar cell will make a minimal impact at this point.

Is the answer legislation? Sure, making the installations easier will certainly help.

I think the biggest hurdle is history. Major changes in energy technology will be hard to implement when fighting the major force that coal, oil, and gas are world-wide. Tough tough spot.

Hi professor. I feel that solar photovoltaic energy production in its current form is unsustainable due to photoelectric inefficiency and the requirement for semiconductors with rare earth elements, not to mention the non-existent recycling of solar panels... where do you see the future heading w.r.t. these issues?

Also, do you have any hope for a hydrogen economy based on splitting water with catalysts that use sunlight as an energy source? We're well on our way to generating virtually free hydrogen (see Daniel Nocera's lab @ MIT).

hyperproliferative

Great question!

Solar panels currently can operate at 25% efficiency - which is pretty close the the theoretical maximum of 32%. So, I think the industry is doing quite well there.

Silicon is actually the second most abundant element in the earth's crust. About 90% of the crust is composed of silicates. So, no rare elements there.

And, First Solar is now recycling solar modules.

So, I think that solar has a shot.

As for a hydrogen economy, I personally would love to see one, but there is one HUGE issue. Our infrastructure is based on carbon-fuels. So, to switch to hydrogen requires massive infrastructure investment. This means tax dollars (which are hard to come by) and or private/public partnerships (like the California/Toyota/Linde partnership).

My job is on the line manufacturing solar panels. The max efficiency I have ever seen used is 20.50%. Is there a theoretical alternative to a Silicon matrix that would increase efficiency and would it be cost effective?

frequencyfreak

Here are the current confirmed record efficiencies of solar cell devices - http://www.nrel.gov/pv/assets/images/efficiency_chart.jpg

As you can see, currently Silicon rules the field.

As a kid, I dreamt of huge bioreactors functioning as artificial leaves that could extract significant quantities of CO2 from the lower atmosphere downwind of a city in a pseudo-photosynthesis process. Could this [theoretically] be done?

hapaxlegomenonically

Theoretically, yes. But, the challenges in this are numerous. First of all, how to concentrate the atmospheric levels of CO2, what catalyst to choose to drive the reactivity required, what product do you want to make, etc. However, many people are working on it (including myself). To learn more about what is going on check out this Department of Energy Hub - http://solarfuelshub.org/

Why do you think the future of electricity is solar and not nuclear? When do you think solar will be able to reach the practicality of a modern nuclear power plant?

The_Good_Count

Unfortunately, many nuclear plants around the country are being decommissioned at the moment. Concerns over nuclear waste storage and operation safety have caused major blockades to future nuclear development.

Solar doesn't have the same concerns.

Why is there so much effort being put into standalone water splitting catalyst technologies? Wouldn't it be more efficient to just use a PV+electrolyzer that has a high efficiency solar cell with the required potential? Or is it a current limitation?

nanoH2O

I think that there are many people approaching the problem from just that way you are talking PV+electrolyzer.

Essentially all the catalyst development underway (including as hyperproliferative points out - in the Nocera lab), can also be employed in this construct. That said, many electrolyzers have moved away from Pt and utilize more earth-abundant catalysts as is (nickel/iron).

Really the limitation overall is making the option competitive with fossil fuels.

I read an article recently about a lab that had found what they claimed to be an efficient and scalable way to take CO2 and turn it into ethenol. Essentially reversing combustion. It was offered as a way to store excess energy from a sustainable grid as ethenol.

Did you read that? Is that a viable storage solution? How important is a storage solution?

kirkendall71

A great idea and something we are pursuing, but unfortunately, no not viable yet.

How can the developing countries replace their coal plants by solar systems? How much scalability is necessary? Roughly speaking how much energy would be sufficient for a family of four in developing countries?

Wowistheword

Average energy use of a household in a developing country - ~570 kWh/yr (a fraction of the near 12,000 for a US household).

The big issue in developing countries is cost coupled to the lack of infrastructure. So, scalability isn't an issue. The issue is how to think small, cost-effectively.

What do you think of Elon Musk's new solar roofing tiles and are they worth it economically?

omnichronos

I haven't done a cost analysis on the technology myself. My guess however, considering other companies that have attempted this is not currently. Indeed, Dow chemical had a solar tile component to their business for many years. Unfortunately, they cut the program because it wasn't cost effective.

There are many challenges here, but ultimately the idea is great in terms of aesthetics. However, if energy generation is your goal, as was pointed out below - traditional solar panels can do it now!

Two parter here: In your experience, what are some of the biggest misconceptions about solar energy you've encountered, and how would you suggest countering them?

Edit: a word

Hail_the_IT_Goddess

The biggest misconception - that unless you live in Arizona solar panels are not cost effective. This is simply not true! Solar can have an impact even in the rainy city of Seattle.

Best way to respond - send them to a calculator to see their payback time -http://www.solar-estimate.org/

At what point is solar energy NOT worth it? As is, I have a westerly facing roof pitch in NY; would adding solar panels really be worth it?

MidnightMoon1331

It turns out that solar can have a major impact even in locations where it is not so sunny. Take Germany for example. They get about 7% of their electricity from solar (and aim for 80% by 2020) despite getting the sun-equivalent of Alaska. That's not to say your return could be greater in a sunnier location. But at the moment local tax incentives actually play a bigger role. To look at your location, try this calculator - http://www.solar-estimate.org/.

Is the organic photovoltaic field dead now that perovskites has zoomed past opv efficiencies? Is there

still viable place for organic semiconductors in green energy or should we just all move over to inorganic bulk hetero junctions?

asianyarg

This is a question that many scientists are struggling with at the moment. Here is what my current position is - we need to keep exploring all technologies, because we don't have any viable alternative to Silicon at the moment. Do I think perovskites are exciting? Absolutely! But there are concerns in regards to stability and environment (the lead). So, until those hurdles are overcome OPV still have a place.

Two ridiculous questions.

I am okay with 'making stuff' and considered making my own DSSC cells for my roof. I know they are less efficient, but I planned on making a model and seeing how long they might last under extreme UV to try and simulate accelerated aging. (I mean, how long can blackberry juice hold up under the punishment of the sun?)

So, would this be a terrible idea-- can you save me the trouble of wasting a few months and my wife looking at me like I am crazy? (I mean, actually being a nut is bad enough. I don't need my beautiful and wonderful wife's face all screwed up at me for no reason-- takes away from the pleasing aesthetic and derails what could have been more enjoyable dinner conversation...)

I am not opposed to having specialized tools or chemicals/process in my shed away from my house.

The two requirements are that they cost less than commercially produced cells (which seem to be unusually expensive for the materials that go into them). And that they will last 10-15 years.

From there, I should be able to come up with a water tight design, set of steps to create a standard form factor, and the circuitry to patch into a commercial load handler (yeah, I'm not building that myself I can get 5V@???A output from the cells to whatever the input is (a Magnum Energy Inverter per se... they have 12/24V@~100A units like this one http://www.solarelectricsupply.com/solar-components/solar-inverter/magnum/the-ms-series-pure-sine-wave-inverter-charger-ms4024).

But, electricity not from fossil fuels is the way forward and I want in sooner than later. Thanks for picking this field and doing this, as ambitious as I am I think my best effort to help is electing people that want to subsidize alternative energy sources...

Q1: The cells are prohibitively expensive-- would you encourage or discourage well made DIY DSSCs?

Q2: Is there a better candidate type of cell for DIY cells?

BradChesney79

First to your DSSC idea, homemade DSSCs for rooftop applications would not be advised. In fact, there aren't any commercial examples of DSSCs for rooftop applications for the following points. As you point out, the natural dyes would degrade quickly (in aging tests I have performed - maybe a few months). Additionally, the solvent required would evaporate without complete cell sealing - which is very difficult. Also to that point, the cells are not tolerant of oxygen or water. Ultimately, the lifetime of the cell would just not recoup the costs to make them.

DIY cells for rooftop applications that would last 10-15 years. That is a tough one. I wouldn't attempt it not, but perovskite cells may be useful in the future. However, you need to be really careful, because they contain lead and again unless the cell is completely tight - the environmental effects may be problematic.

Hi! Do You think algae generating hudrogen and hydrocarbons as a side product of their modified photosynthesis process could actually compete with typical photovoltaic solar farms in terms of energy efficiency? We seem to have reached a soft limit and most innovstions in photovoltaics seem to be in the field of WHAT can we coat with solar sensitive materials, rather than how efficient these materials actually are.

zamach

Natural photosynthesis is only 3-6% efficient. Solar is at a max of 25% for a single cell.

Why are panels made so heavy, the aluminum and glass is inflating the price, cells and cables from a 100 w panel weighs around 250 grams I've learned, what do you think?

I think we should put them in a much simpler enclosure, such as thin transparent plastic, and design it so that it wouldnt change much if one cell got broken,

and also spit out panels from factories at maximum speed without regard for market prices.

1980sumthing

Polymer encapsulates are actually better than glass - and used quite often. Dow corning has a program dedicated to exploring silicon based polymers for solar applications. The problem comes in the gas permeability of the materials - which means they layers still have to be thick.

If the same amount of governmental financial initiatives where given to the renewables sector, as they have been to the oil and gas industry, what kind of market would you see emerging from this financial benefit?

UnexpectedCensorship

Solar would be competitive cost-wise for sure. I would hope that energy companies would begin to enter the solar market and provide the renewable energy either through distributed leasing or solar fields.

Hello, thanks for doing an AMA! I'm currently trying to change careers, I'm mid 20's and interested in programming (I know, how *unique*) and math. Is there a career in solar (or any other green energy career) that you know is not currently having demand met? Or is every position flooded with candidates? I know I want to work in the clean energy/ renewables sector, but I'm not sure how much math or programming they really involve. Probably more in the research phase if I had to guess.

Also, does your own home have solar or other green energy sources?

tastyjustice

There are opportunities in modeling solar cell materials and devices. It isn't my exact area of expertise, so unfortunately, I can't point you to an exact answer.

We looked into solar panels, but our roof isn't currently to code. Lucky for us we saved the money to make these upgrades and are doing them now. Solar panels are the next step.

Right now it seems like the solar market survives primarily as a result of government assistance. I say this because at the moment, it seems like solar panels efficiency isn't high enough to make it a viable alternative on the free market.

What is the current efficiency solar panels are outputting, and what efficiency level does it become a viable alternative to other energy sources on the free market? Also, when you do you foresee reaching that tipping point technology wise?

TheBurningOak

Even without government incentives solar payback would occur before the life of the panel. The huge price difference between conventional energy and solar actually comes in the balance of systems cost (installation, components, etc). The tipping point will occur when we get these prices down.

Solar cell efficiency for common rooftop cells is around 20%.

Do you think solar-cell technology innovation has run its course? IE: Mono/Polycrystalline silicon and maybe CdTe are going to be it when it comes to utility and commercial scale solar? Or will more unique semiconductors (or perovskite layers) prove their worth?

FourierXFRM

Currently, Silicon runs the market and I think it will for quite some time. Perovskites are intriguing, but not a proven industrial technology yet - probably need 20 years.