Science AMA Series: I'm Paul Wyman, Senior Scientist at DSM, I develop materials for solar panels, AMA!

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Abstract

I'm Paul Wyman, Senior Scientist at DSM, a global science-based company active in health, nutrition and materials. My specialties are polymer synthesis and coating technology. At DSM I am part of a research team developing materials to improve the performance of solar panels. With the majority of the world's greenhouse-gas emissions being produced from fossil fuel consumption, research and development in the renewable energy sector are key steps towards tackling climate change. We are working on a portfolio of innovations focused on lowering the cost of solar energy by providing solid, durable and sustainable materials. Our solutions include light trapping technology, anti-reflective coatings, backsheets and an anti-soiling coating. Here's a little bit about my colleagues who will be joining me during today's AMA: Peter Pasman - PhD in physics, expertise in optical modelling Damien Reardon - PhD in chemistry, expertise in sol-gel chemistry and thin film coatings Ian Bennett - Expert in photovoltaic modules We will be live from 10:00 EST (16:00 CET) and will stay online for a few hours. We welcome your questions about renewable industry and our solar energy solutions. AMA! 10:00 EST - Hello from our team! We are live and ready to answer your questions. Ask us anything! 12:24 EST - Thanks for your questions today. You've certainly got us thinking and challenged us with some important topics. We hope we've provided you with some useful answers! Solar is a very motivating and exciting area to be working in, with plenty of science still to do to address one of the big issues of this generation - and it's great to be part of it. Lots of your questions are about energy storage, better, more efficient, solar capture and the additional benefits solar can bring to society, please do take a look at our current Bright Minds Challenge as these up-and-coming pioneers have the potential to really take things forward in this space. Thank you for making our first Reddit AMA so welcoming and so much fun - we enjoyed it, hope you did too!

the WINNOWER

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Science AMA Series: I'm Paul Wyman, Senior Scientist at DSM, I develop materials for solar panels, AMA!

PAUL_WYMAN R/SCIENCE

I'm Paul Wyman, Senior Scientist at DSM, a global science-based company active in health, nutrition and materials. My specialties are polymer synthesis and coating technology. At DSM I am part of a research team developing materials to improve the performance of solar panels.

With the majority of the world's greenhouse-gas emissions being produced from fossil fuel consumption, research and development in the renewable energy sector are key steps towards tackling climate change. We are working on a portfolio of innovations focused on lowering the cost of solar energy by providing solid, durable and sustainable materials. Our solutions include light trapping technology, anti-reflective coatings, backsheets and an anti-soiling coating.

Here's a little bit about my colleagues who will be joining me during today's AMA:

Peter Pasman - PhD in physics, expertise in optical modelling

Damien Reardon - PhD in chemistry, expertise in sol-gel chemistry and thin film coatings

Ian Bennett - Expert in photovoltaic modules

We will be live from 10:00 EST (16:00 CET) and will stay online for a few hours. We welcome your questions about renewable industry and our solar energy solutions. AMA!

10:00 EST - Hello from our team! We are live and ready to answer your questions. Ask us anything!

12:24 EST - **Thanks for your questions today. You've certainly got us thinking and challenged us with some important topics. We hope we've provided you with some useful answers!**

Solar is a very motivating and exciting area to be working in, with plenty of science still to do to address one of the big issues of this generation - and it's great to be part of it.

Lots of your questions are about energy storage, better, more efficient, solar capture and the additional benefits solar can bring to society, please do take a look at our current Bright Minds Challenge as these up-and-coming pioneers have the potential to really take things forward in this space.

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Hi Peter, Damien and Ian

Thanks for doing this AMA!

Solar specifically, and renewable energy in general, is the way of the future.

I thought I would get your views on a few thoughts:

1. Elon Musk's solar roof tiles - is it as amazing as he promises when he launched it, in terms of efficiency and cost?
2. Transparent solar panels that double as windows - there has been some recent developments - any updates to whether this is possible?
3. Solar roads - trials in France and the US have started - is this practical?

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4. Solar powered grid/ solar farms - there has been significant developments in the Middle East, Russia, China, India, and Australia - is this the future? Is our battery technology sufficiently advance enough to support this?

Thanks in advance for entertaining my random questions. Keep up the good work!

mvea

1. Any technology which enables broader adoption of solar has to be good, so roofs which generate electricity and look nice are a great idea. Technically though, the fewer connections between tiles or panels, the more reliable the system, so big tiles might be better than small ones. As for cost vs efficiency, these systems have a dual function so are likely to be more costly. Efficiency, likewise, may also be a compromise. So to answer your question, yes, i hope so!
2. Indeed, transparent panels that double as windows are an interesting addition, as are building facades, although these will inevitably be less efficient than non transparent fully optimised solutions both due to their non optimal orientation as well as the need for a certain amount of transparency.
3. Nice idea, although soiling, damage and maintenance may make this difficult in practice. Placing panels next to or over roads would currently be more beneficial
4. Large solar installations, i believe, will form a significant part of total energy generated in the future, and indeed this must be the case in order to fulfil global energy demand without an ever increasing reliance on fossil fuels.

Energy storage solutions are evolving rapidly as is general awareness of the need for system thinking to integrate current grid infrastructure with an increasing contribution from renewable resources such as solar. These technologies are evolving in parallel, and yes, energy storage solutions including batteries are looking like being advanced enough to support this. - Paul and Ian

Can you talk a little about the economics of the direct to consumer sale of solar? As the technology develops so rapidly, at what point does it make sense for a consumer to invest in a large-scale conversion in power? Systems today are too expensive for the average household to scrap and replace every few years, and yet it seems like the efficiency and efficacy of home energy generation and storage is changing so rapidly it's hard to know when to "jump in".

A second question- what are the current challenges of home-storage of self produced energy? Are we "there yet" in battery technology? If not- where do you think the research or development is lacking?

p1percub

The price of PV systems have dropped the last 5 years dramatically. Making them more accessible for the average household. It is true that efficiency will increase over the next years. However, the payback time at the moment of most systems in the EU is already reduced to 4 to 5 years. So it is good to jump in now to make the advantage of what is already out there. Panel efficiency is approaching 20% currently. It would make sense to keep the system for 10 to 20 years, depending on the speed of development. Current developments looks very promising. There are a lot of scientists driving great initiatives that are ready to scale. Check sciencecanchangetheworld.org and get inspired by these bright ideas.

Re your second question, there is a lot of research and technological development in battery for home and industrial storage. This is an enabler for all forms of renewable energy to reduce the effect of intermittency. The cost of storage is dropping rapidly, also with the increasing market for electrical vehicles. I expect this price drop to continue making the combination of storage and renewable even more competitive with fossil fuel generated electricity. - Ian

Have you personally felt any effects of pushback in regards to solar progress from the powers that be, namely politicians or big oil?

b4upunchme

I see plenty of opportunities in solar and plenty of initiatives actively encouraging research in this area. Solar races such as the World Solar Challenge really help motivate young people to get into this area too. Pushback, resistance, no, not from where I'm standing.

Thanks for doing the AMA. My question is regarding the availability of materials used to make the solar cells - do your products/research use 'critical materials', ie rare earth's like dysprosium, terbium, europium, neodymium and yttrium, which we have short supplies/suppliers already, and if so, how do you plan to work with or around those restrictions?

thiney49

Good question! It would be an awful shame to service our energy needs and meet CO2 emission targets by having "mined the whole planet" with all the associated consequential damage that would cause. I certainly believe we should reserve critical materials for critical applications and use them in a considered manner. If in the short term, in order to make progress in sustainable energy where these are needed, we should ensure that these are used sensibly or can be efficiently recovered. So yes, we occasionally use such materials in research, but strive to find sustainable alternatives before going to market, in line with the DSM company vision.

I live about 60°N and have limited sun parts of the year, and quite a bit of snow. Do you think solar panels is a good investment, both economically and environmentally for consumers at my latitude?

Can you give me some good arguments to invest in solar panels for my home?

jurgemaister

Environmentally for sure, economically maybe. This depends on your energy tariffs as well as energy consumption, although if you have space, can afford the investment, and wish to take full advantage of solar energy, there is an emerging technology known as "bifacials" which will take full advantage of reflected light from the snow since these modules are able to gather light from both their front and back. - Paul

Hi there! How do you guys see the growth of organic-based solar cells? Especially those organic-inorganic perovskite solar cells? Will it take over standard silicon solar cells in the future or will it be limited to laboratory experiments? Thanks!

lihiki

I believe organic based solar cells (OPV cells) and perovskite based cells are two different cell technologies which both have their advantages and disadvantages. I believe the efficiency OPV cells are currently low and the growth rate of their efficiencies will be limited in the next 5 to 10 years. The main drawback of such cell technologies remains that long reliability and degradation in outdoor testing is quite poor.

On the other hand the growth rate of perovskite based technologies has been quite steep in the last 5 years reaching 22.1% at cell level. Large scale cell production and long term reliability are also the main challenges the technology needs to be overcome. Given the effort the scientific community is

currently putting in solving these issues, we are looking into great breakthroughs in the future. Check out the NREL Efficiency Chart showing cell efficiency growth over time. - Damien

I heard a few years ago on a news report that we were running out of materials for solar panels, which has been proven untrue. Was there any truth to this (have we found a different way to make the panels?) or was the whole report a bunch of mumbo jumbo?

Delpy294

There is partial truth to this affirmation as large scale c-Si cell technology is highly dependent on supply and demand of high purity silicon and silver. A few years back there was a shortage of Si and the price of Si rose dramatically. The market re-adjusted and supplied more c-Si and the price dropped again. The current demand of such raw materials is not high as there is a surplus on the market and prices are low. If we consider newer alternative thin film technologies which contain limited quantities of raw material we believe the solar market will look into finding a solution where abundant materials are available as low cost of energy will ultimately decide large volume adoption of the technology. - Ian and Damien

What are* the enviornmental impacts of a broken/discarded solar panel?

PauperPhilosopher

Modules can already be recycled to a high percentage due to the high weight fraction of glass which can easily be separated. However, the polymer fraction cannot currently be recycled and is incinerated. As end-of-life PV waste streams will grow in the future, special processes will be required for recycling. This has, for instance, already been developed for technologies such as thin film CdTe.

Have you encountered what felt like people abusing their position of power to thwart your progress?

tobygain

I often feel like molecules abuse their position of power, although maybe as a chemist i should blame atoms instead. In my experience, the people in my surroundings are well behaved, unlike their molecular counterparts who often thwart progress :-) - Paul

Hi all,

When I was taking MatSci classes in school, I remember the big drawback of solar energy being that we lacked the technology to make the cells produce enough energy to be a viable energy source for most uses. Has that changed? If jot, how far away is that? What efficiency are you seeing in the cells now?

goldenpanda22

Potential for solar energy is 86000 TW calculated from the amount of light that reaches the earth. Global energy consumption is 15 TW, so solar will be able to provide more than enough energy. Especially combined with other renewable energy and storage, there is more than enough space either on roofs or in field for solar to provide enough energy to replace fossil fuels.

The current highest performing cell technologies are based on GaAs semi-conductor materials. These cell efficiencies are of the order of 38.9%. This essentially means that 61.1% of the light entering the

cell is NOT converted to an electrical current. Check this out. From this perspective the light conversion to electrical current is high. Looking at the attached graph you will also find the most common c-Si cell type which has a record cell efficiency of 25.6% but this is not what is found back at module level.

More importantly, I think we need to consider the cost of production of power (euro/kWxh) which includes solar module production cost and installation. Currently c-Si modules offer the lowest cost of energy production and are based on ~20.0% efficient modules. The cost of energy production from such solar modules is at grid parity in most western countries and is competing with energy production based on traditional technologies. - Damien

What are the common downsides of solar energy? I've heard about melting/extra heat, but is there anything else we should be aware of?

quietlyinvisible

Photovoltaic panels can get warm during operation, typically 30 degrees above ambient temperature, but never close to melting. Some forms of concentrated solar power do rely on molten salts to power steam turbines, but this is a different technology than conventional solar panels.

There are a number of safety tests that a solar panel has to pass before being commercialised, including for example a flame spread test. These tests ensure that the panels are safe for installation. - Ian

Do you see any potential applications of your materials in thermal solar power (i.e. trapping solar power as heat in oil for later use in a power plant or in heaters)?

kelvindegrees

We are currently focused on photovoltaics and not thermal solar power but we don't rule this out for the future.

What are the environmental costs (greenhouse gases, water pollution, etc) of solar panel production? I know they don't produce any while operating but surely the manufacturing process has some serious emissions?

Thank you for doing this AMA!

JaffaCree

Typical energy payback time of current solar panels placed in, for example, Europe is 3 to 4 years. This is the time needed to produce more energy than the energy required to produce the materials need to make the panel. A panel typically has a life-time expectancy of over 20 years, far exceeding the energy payback. There are a number of articles available looking at life-cycle analysis of solar systems and comparing them with other renewable and conventional systems. Take a look at this.

What's preventing everyone working together and covering most of the Sahara in solar panels?

doctatortuga

Although there is a lot of potential for solar in the Sahara due to the amount of sun, there are a number of drawbacks to placing large installations in the desert. The efficiency of solar panels is sensitive to

temperature, with a significant loss of efficiency to be expected at the temperatures commonly seen in the desert. The remote location would result in transport losses of the generated current and would make maintenance of the system more difficult than if it was less remote. The desert is typically a dusty location and dust on the solar installation would reduce the current generated or increase the maintenance costs due to cleaning.

There is enough space at less remote locations than the Sahara to generate a significant portion of the electricity required today. This being said, it would be great to be able to place large areas of solar panels in deserts, so solutions to controlling dust such as by planting vegetation, use of anti-soiling coating and methods of improving thermal efficiency such as cooling or by use of intrinsically less thermally sensitive light absorbers are most welcome. - Ian

How much effort do you put in to modifying the refractive index of your coatings? Classic acrylate coatings are all similar RI, styrene helps, but it's a bad idea outside. What monomers are useful for modifying RI that are robust to direct UV exposure?

nate

Depending on what you wish to achieve ie increase or decrease RI, you have the option of adding high refractive index inorganic fillers or conversely of creating voids, in the latter case this is most commonly applied to inorganic based layer such as those used to produce anti reflective coatings on solar module glass for instance. Specific monomers useful for modifying RI, which are outdoor / UV stable are indeed hard to come by. For a resource on additives and their impact you could try this out. - Paul and Damien

Hi & thanks for doing important work for everyone and -thing on this shared planet of ours! My Q is more political than scientific. To what extent would you say that the development, implementation and popular distribution of solar panels are hindered by political decision-making, commercial interests outside the renewable energy sector and regulations favouring old energy production systems? While maybe a national/regional question, I fear that different regions face similar problems. In my supposedly eco-friendly country, farmers who got funding for setting up windmills etc have fought for years in order to be connected to the power grid so they can supply their excess power production on the open power market. I.e. there is no financial kick-back for producing surplus power, perhaps due to large scale privatization of the power sector in my country (Norway) the past decade. Similar hindrances are many. Any thoughts?

Gonzouela

Political decision making indeed impacts the development and distribution of solar panels. The good news is that 195 countries adopted the Paris Agreement at the UN Climate Change Conference in 2015, to create a global policy framework. With that agreement, the long term goal of a net zero economy by the second half of this century has been set. The transition to a thriving and low-carbon economy will be accelerated with this, which means positive news for the renewable energy business rather than a hindering situation, I believe. - Paul

Paul - I'm a mechanical engineering student (junior) who's had some basic research experience. What you do is pretty much where I'd like to aim my career. I'm also anxious about finding a research internship this summer.

Two questions

1 - With your anti-reflective / light-trapping coatings, what sort of efficiency gains have you seen? Will your future work aim to increase that, or improve different areas of solar cells?

2 - Do you offer internships? I'd be happy to send you some application materials.

Gen-Ross

Thanks for your question and enthusiasm for this subject area, great to see. For anti reflective technologies in general, we see about 3% in lab tests and up to 4 % in the field depending on location / installation. We do offer internships, although entry is very competitive, please see our website for details. - Paul

Hi all, and thank you for doing this AMA!

Silicon solar cells have nearly hit the Shockley–Queisser limit, and alternative technologies are rapidly improving. Do you see silicon getting dethroned any time soon, or will falling prices of pure silicon/limits on other technologies keep it on top?

AidosKynee

There is still some way to go for mass production of silicon cell with efficiencies close to the Shockley-Queisser limit, but it is approaching. The advantage that silicon has is the large base for production and the track record as far a durability in the field goes. Several of the competing technologies are not yet produced at sufficient volume to be competitive on price and don't yet have the durability track-record. The challenge for these new technologies is made more difficult by the continuing drop in price of silicon based PV. One of the most promising developments to break through the QS limit is the use of tandem cells combining two or more types of cell sensitive to different wavelengths of light. This make more effective use of the available spectrum and so should allow the production of more current and so more energy. - Ian

What is the environmental cost of producing a solar panel today and, on average, how long does it take for it to be really environmentally friendly?

Arrp00994

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Not that you guys are experts on this field but Do you have an estimate on when we will have the ability to combine super(or ultra)conductors with ultra efficient solar panels and other forms of natural energy generation for almost complete individual electricity generation per home

OriginCSGO

Yes, the technology combination is interesting although as you mention these technologies do not exist yet for mass production. It is therefore quite difficult to estimate when this technology package would be available to the common person at low cost. - Damien

What about energy storage? As technology has improved with solar collection, I have not seen the same advances in affordable storage capacity or costs. Are you working on that problem as well and can you share with us any new concepts?

beaufordtshimbucket

Yes, next to improving solar collection, we are also working on energy storage in our business incubator. Just to give you an example of how serious we take research in this area: together with the ACS Division of Polymer Chemistry (POLY) we reward excellence in innovative PhD research related to Advanced Polymers in Energy Storage Applications. Furthermore, as we believe very much in open innovation, we started the Bright Minds Challenge together with partner companies and institutes to find and scale up the most promising solar and energy storage solutions. - Paul

Thanks for your time. What will be the "Next big thing" in solar that we should know about.

captdet

I think that one of the key challenges is to integrate systems, this will require cross state, cross country collaboration, on systems which do not currently exist, but which are being developed. To be more specific the the cost of solar panels are coming down, the capacity is going up and the appetite for large scale deployment is growing. In parallel, there significant developments in energy storage and an increasing understanding of how to predict and handle the output from solar sites (through changing cloud cover for instance) . So the next big thing is system integration, backed up by strong and continued development in both PV and battery technology as well as control systems to enable their integration. Geographic positioning and cross border cooperation will, i believe be key to the long term of sustainable energy security.

For photovoltaics, durability and performance improvements are pretty big things, as well as the challenge of not only scaling towards large parks and commercial installations, but also diversifying towards building integrated, architectural and portable applications. - Paul

I read the other day that even if they plastered every usable roof in the USA with solar panels it still would only provide about 40% of power. I thought solar was getting better that doesn't sound very good to me. Do you forsee any big leaps coming in the future or is solar pretty much just a pipe dream?

RiffChord

Potential for solar energy is 86000 TW calculated from the amount of light that reaches the earth. Global energy consumption is 15 TW, so solar will be able to provide more than enough energy. Especially combined with other renewable energy and storage, there is more than enough space either on roofs or in field for solar to provide enough energy to replace fossil fuels.

There are technologies which use toxic materials. We don't use those and focus on developing a portfolio of sustainable materials. Only last week, we announced that we acquired a technology to produce backsheets without using fluorinated materials. This way we strive to protect the environment through sustainable products.

But we know there are many more ideas, creative thinking and innovations that one team and one organisation alone will not be able to find. For this reason, before Christmas last year, we launched a new global challenge called the Bright Minds Challenge. Do take a look at some of the great solutions that have been entered as I think they are beginning to provide some of the answers to your questions.

What are the physical, biological, chemical....etc limitations that scientists are coming up against as they try to design more efficient solar panels? What's the average wattage that lab vs commercial panels are outputting?

GetTheeAShrubbery

There is a limit to the efficiency that a solar cell can reach known a the Shockley-Queisser limit. This is dependent on the type of material used to make the cell. This is a physical limit related to the ability of the material to absorb sunlight and the efficiency with which this light can be used to generate a current. For silicon based solar, this limit is about 32%. Commercial silicon cells are available with an efficiency of up to approximately 24%, with the most efficient lab cell over 26%. Typical solar commercial panels with a size of 1 x 1.6 m containing 60 cells can produce in excess of 260 W, with the best panels producing over 300 W. There is a very nice article by Prof Polman on this topic in science. - Ian

Hi there.

What do you think of Solar City and the solar roof tiles instead of panels attached to the roof of a building?

Also, are solar panels becoming more efficient at absorbing solar energy? If so, how and why? Thanks!

Nicman2004

Any technology which enables broader adoption of solar has to be good, so roofs which generate electricity and look nice are a great idea. Technically though, the fewer connections between tiles or panels, the more reliable the system, so big tiles might be better than small ones. And yes, panels are becoming more efficient. The widespread adoption of anti-reflective coatings, the optimisation of current collectors including back contact technology as well as improved processing and higher transparency encapsulates all contribute to improved efficiency in commercially available panels. - Paul and Ian

Hey there!

Recently I read, from multiple sources, about a new material that had the capability of turning sunlight, heat, and movement into electricity at once.

1. How could this material improve the performance of solar panels?
2. Could this be used to build a kind of "superpanel" that could use all three of those properties to gather electricity?

Ras1018

I assume you refer to the work on “Ferroelectric, pyroelectric, and piezoelectric properties of a photovoltaic perovskite oxide” by Bai et al. in Applied Physics Letters. These material developments are very interesting and relevant. Currently, commercial solar modules convert only a fraction (~20%) of sunlight into electricity. Most of the energy is lost as heat. Therefore, materials with a tunable bandgap and that would be able to convert some of the generated heat into electricity could definitely help to improve the performance of solar panels. If also kinetic energy can be harvested, this would indeed create a kind of “superpanel”.

On the other hand, to develop this material into a commercial and durable solar panel or “superpanel” (if possible) will still require a lot and many years of research. I definitely agree with the closing remark here in Science Alert: “As is often the case with these kinds of discoveries, it will be a long time before

the mineral is developed for market use, but the research does show that we're still not even close to knowing all there is to know about Earth's mineral properties." Although it is definitely good to keep an eye open on anything that could improve our ability to harvest sunlight, and i like the idea of superpanels! - Peter

Peter, quick question: How hard is a PhD in Physics? Sorry if this seems off-topic...

SterlingWorldWaker

Not an easy question to answer actually. I would say, as with most PhDs, you need a genuine interest in the subject and much dedication and perseverance. You go through many ups and downs, but eventually you will also learn a lot, about the subject and in particular about what it implies to perform research. How this compares to other fields (than physics) is difficult to say, but I would say that it is more important to focus on a field you are most passionate about. - Peter

You say a majority of green house gases are produced by fossil fuels? Not farming?

Monkeyleg

Methane is indeed also a large contributor as a greenhouse gas. Therefore at DSM, next to our solar activities, we are also working on producing a feed additive to address this issue. Check this out for more information.

Hello! Thanks for taking the time to answer questions. With all the advances in solar technology recently, I've had an idea for a backup that is made from a solar fabric perse, and less from traditional materials. Is this at all feasible in the near future? The idea being that mainly the top and back, outer areas most exposed to the sun when hiking, would be made of a solar 'film'. Possibly this film is just pliable enough to be used over a traditional backpack and feeds a battery placed inside of a pocket in the backpack. Thanks!

Tsquaredp

Great idea. We are constantly looking for bright ideas about how to benefit more from solar power. And the solutions for applying solar seem to be endless. Solar panels can be flexible, so indeed be used as exterior of a backpack like you suggest.

We recently launched the Bright Minds Challenge and invited innovators across the world to submit solar and energy storage solutions that they believe are ready to be scaled up, like portable solar solutions. Unfortunately the date to enter your idea is over, but you can still vote which solution you think is the most-ready to scale. - Paul

I live in an apartment building with several small vertical windows and no access to roof (as do most people in my country).

How can I incorporate solar panels into my life?

Soktee

There are a number of concepts for generating electricity from windows including fluorescent concentrators and windows with cells in the frame and semi-transparent mirrors. Some nice 'smart city' solutions can be found here: VENZA, Crosslux, WrightGrid, BeON energy. In some countries it is

possible to invest in solar panels installed in a solar plant and to use electricity generated by this plant. As an alternative, business models with renting/sharing of other people's rooftops are being introduced and may be an alternative. - Ian

What are your thoughts on Rayton Solar? They claim to have developed an industry first technique using lasers to create Ultra thin photovoltaic material at seemingly incredible cost reductions. They've even enlisted the reddit hero Bill Nye as a spokesperson.

Mr_Monster

Reducing the amount of silicon used is one of the ways of reducing the cost of solar energy. The process has to be competitive with the current method of sawing wafers from an ingot. Ion bombardment, as developed by Rayton, and alternatives such as epitaxial growth of silicon and direct crystallisation of a wafer from molten silicon are a number of methods of obtaining thinner wafers without saw losses. In all cases, they have the potential to be cheaper than sawing, but need to be scaled up to be competitive. There is also a limit below which a wafer becomes less efficient when used to make a cell. Typically this is around 50 microns. This type of thickness needs to be attainable by the new processes. They have a nice video by the way! - Ian

A solar panel contains many cells within the panel. It seems they are wired in series so that if, for example, 50 percent of the panel is covered with snow or shade, the panel puts out far less than 50 percent of its potential. Are new panels addressing this issue?

GreyDeck

The cells are wired in series as they produce a relatively high current at a low voltage. To limit the electrical losses in the module, the current should be kept as low as possible. Increasing the voltage makes the power coming out of the module more compatible with the network. Losses through shading can be high due to the series connection. There are developments using smaller cells with alternative circuits which are more tolerant of shading (take a look at this). It is also important to consider shading when installing panels and to limit it to a minimum where possible.