Cutting photons for photovoltaic applications "SSQC"



Image and data processing by NOAA's National Geophysical Data Center. Defense Meteorological Satellite Program data collected by the US Air Force Weather Agency. This image has little or nothing to do with the talk

Cutting photons for photovoltaic applications "SSQC"



Universiteit van Amsterdam

CEOT



loffe (St. Petersburg, Russia)

T. Gregorkiewicz, I. Izeddin, D. Timmerman (UvA)P. Stallinga (CEOT)I. Yassievich (Ioffe)

Stallinga is an expert on solar energy

Pesquisa, Grupo da Universidade do Algarve, liderado pelo holandès Peter Stallinga, participa num projecto internacional que vai aiudar a methorar a eficácia dos painéis solares

Algarve ajuda a partir fotões

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Reports in all major national newspapers (CdM, DN, etc.) Interview on TV (TVI) Interviews on radio (Antena 1, RUA)



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ARTICLES

Space-separated quantum cutting with silicon nanocrystals for photovoltaic applications

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Hot topic

Global climate change is HOT TOPIC !! (big business!) "The industry of fear"



Source: http://www.global-greenhouse-warming.com/graphs-diagrams-of-global-warming-and-climate.html







"These people that are modelling (predicting) a Global Warming should change their field to the much simpler and more predictable area of Economy. The (about) 250 thousand economists failed to predict the current crisis and fail now to model how to get out of it (and they should therefore lose their jobs)"

Stallinga, June 2009



Albert Gore Jr. Failed politician. Failed climatologist or career in Economy?





New 'bubble'

Renewable energies (as a way to solve the Global Warming) is a hot topic. High scientific and (recently) commercial interests.

It is the new 'bubble'





New 'bubble'

Renewable energies (as a way to solve the Global Warming) is a hot topic.

It is the new 'bubble', after

- the tulip bubble ('Tulip Mania') 1637. Originally a flower from Turkey it has made The Netherlands famous (and rich). The Tulip Mania was the first recorded economy bubble







Renewable energies (as a way to solve the Global Warming) is a hot topic.

It is the new 'bubble', after

- the tulip bubble ('Tulip Mania') 1637.
- the train hype and Gold Fever (San Francisco) 19th century









Renewable energies (as a way to solve the Global Warming) is a hot topic.

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Renewable energies (as a way to solve the Global Warming) is a hot topic.

It is the new 'bubble', after

- the tulip bubble ('Tulip Mania') 1637.
- the train hype 19th century
- Internet bubble ('DotCom') end 20th century.
- Financial crisis (now) and house market (imminent)







New bubble

The next decade will see strong investments of society in renewable energies



Ponzi



Madoff

Never giving any return, apart from dividends of the type Ponzi Scheme [for example Madoff 2008. Old 'profit' is paid by new investors]



Investing money in Renewable Energies





If fossil fuels are limited:

The Global Warming problem will solve itself; It is a NON-ISSUE







If fossil fuels are limited:

The Global Warming problem will solve itself; It is a NON-ISSUE Takings counter-measures will only delay the problem (and destroy the economy and destroy billions of lives on the way)



* Planting trees is not a measure



"Photon cutting"



Solar cells are the best bet for renewable energies. (Note that for instance hydrogen is not a fuel, it is an energy carrier)

If a certain area is used for producing energy, solar panels are best option.

As an example*:

- the best bio-fuel (palm oil) has an efficiency of 0.17% (approx. 3.5x10⁴ kWh per hectare per year)

- a Si-based photovoltaic cell has an efficiency of 14.3% (approx 3x10⁶ kWh per hectare per year)

Solar cells can be placed in useless areas (deserts, rooftops, etc.)



* Source: MRS Bulletin **33**, 384 (2008)







Solar power









Economical viability

Solar cells are economically not viable (break-even > 20 years)

Price of barrel of oil will not change this



Cost of production of solar cell directly related to energy price because Silicon has to be molten to purify it to levels of 99.99999% and crystallized



Cz crystal pulling furnace





Solar cells are economically not viable (break-even > 20 years)

Price of barrel of oil will not change this

Cost of production of solar cell directly related to energy price because Silicon has to be molten to purify them to levels of 99.99999% and crystallized

Strong (government?) intervention is needed to overcome this problem Or maybe strong speculation on profitability ('milking' the investors)

Technological breakthrough is needed.



(Political) independence from foreign energy sources, in any case, is very desirable for any country.

Conclusion: studying the subject of renewable energies is not economically interesting, but any way essential for our society.



The renewable energies disaster





Relevance

When scientists are asked ...



From a guide for helping interaction of scientists with the press





Relevance







Not much can be expected from the other end of the equation, namely consumption of energy, for instance efficient light sources (other research area of CEOT).

Instead of a reduced energy consumption, reduction in energy cost for illumination will increase consumption of illumination.





"Photon cutting"

CEOT 5.VI.2009, P. Stallinga (pjotr@ualg.pt)



Faro 2020?



Energy of photon is absorbed to create electron-hole pairs Electrical field drives them to opposite electrodes External current observable



Solar cells 2: Shockley-Queisser Limit



Best Research-Cell Efficiencies

www.nrel.gov/ncpv/thin_film/docs/kaz_best_research_cells.ppt





NSEL



Beating the Shockley-Queisser Limit



Photon cutting"

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"Everything that **can** be done with silicon **will** be done with silicon!"

If an improvement of efficiency can be obtained with silicon (however small it is) it will have HUGE commercial impact.





Nano crystals (NCs)





28/44



"Photon cutting"











Photoluminescence, Erbium





Quantum efficiency





Er-PL Quantum efficiency



Space-separated Quantum Cutting (SSQC)



"Photon cutting"

CEOT 5.VI.2009, P. Stallinga (pjotr@ualg.pt)

Space-separated Quantum Cutting (SSQC)



(NB: non-destructive process :-))





NC Quantum efficiency



Space-separated Quantum Cutting (SSQC)









Beating the Shockley-Queisser Limit 2



Future work



"Photon cutting"

CEOT 5.VI.2009, P. Stallinga (pjotr@ualg.pt)

Future work



Universiteit van Amsterdam

Determination of kinetics of SSQC phenomenon

- Time-resolved (fs) induced absorption
- Time-resolved (fs) photo-luminescence

very impressive, colleague

but, does it also work in theory?





Electrical characterization of real solar cell or prototype, REAL EFFICIENCY





Impact

With this new phenomenon, the watts-per-m² can increase possibly by 50%

Consumption of energy in Portugal (in TOE, tons-of-oil-equivalent)





Area necessary to produce ALL energy by solar cells. Portugal independent! Portugal WITHOUT pollution





Thanks



Prof. GregorkiewiczSalvatore Minissale Wieteke de BoerBert ZwartIgnacio IzeddinDolf TimmermanNgo Ngoc Ha
Peter Stallinga

We don't claim global warming, we don't crash banks, we work on solutions!







Solar energy. The future in our hands



10Q4ur@+ion

