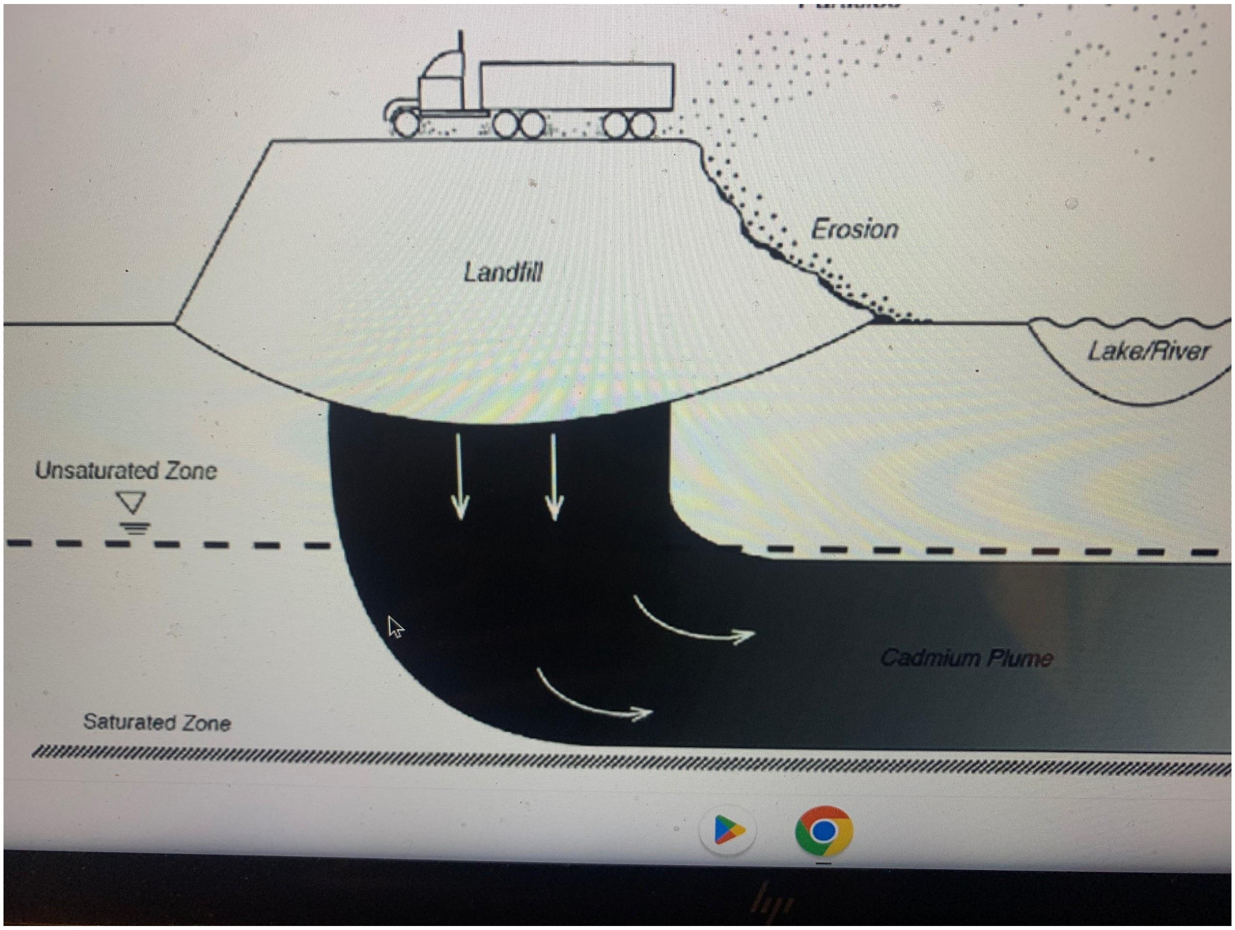
This is PAYDIRT for research on CdTe thin film solar panels. It is a collection of research articles addressing our concerns about cradle to cradle use of toxic substances over our Aquifer, private wells, deforestation reduction of our protective filter, consequence for long term weathering, and disposition of these panels after the end of their use.

LONGROAD has said clearly and repeatedly that they do not intend to hold onto them for the warranteed? 30 years that has attached the caveat that all forward looking statements are iffy have no legal bearing- and that since the production was on in 2006, that these panels have no long term track record, only expectation projections. see SEC 2021 REPORT for FIRST SOLAR,. https://s2.q4cdn.com/646275317/files/doc_financials/2021/ar/First-Solar-Annual-Report-2021-Web-version-(final-from-Merrill).pdf RISKS p.18

Most of the research is from the last couple of years.

\Fig 1 - uploaded by Heather J AvensContent may be subject to copyright.

Cadmium release pathways: schematic of contamination to groundwater, surface water, air and soil from landfill.



The blackened text says CADMIUM PLUME.

Landfill waste and recycling: Use of a screening-level risk assessment tool for end-of-life cadmium telluride (CdTe) thin-film photovoltaic (PV) panels

Article

Full-text available

- May 2014
-

- William D. Cyrs
- 
- Heather J Avens
- 
- Zachary Capshaw
- [...]
-
- Brooke E Tvermoes

Grid-connected solar photovoltaic (PV) power is currently one of the fastest growing power-generation technologies in the world. While PV technologies provide the environmental benefit of zero emissions during use, the use of heavy metals in thin-film PV cells raises important health and environmental concerns regarding the end-of-life disposal of...

Contexts in source publication

Context 1

... exposure via groundwater and surface pathways were investigated using DRAS. The specific exposure routes considered are tabulated in Table 2. Fig. 1 depicts the cadmium emissions of interest: cadmium in leachate migrating to groundwater, cadmium emission to surface water from water erosion, and cadmium particulate emission to air from truck traffic and from wind ...

View in full-text

Context 2

... groundwater exposure routes that were evaluated in this study include: (1) ingestion of groundwater; (2) dermal absorption from groundwater sources via bathing; and, (3) inhalation of volatile constituents released from groundwater during showering (Fig. 1; Table 2). Not all of these exposure routes are applicable in the case of cadmium, however. As noted in Table 2, carcinogenic risk for CdTe PV panel disposal was not calculated for the water and dermal exposure routes, since both of these calculations depend on an oral cancer slope factor (CSF), a value that has not been determined by ...

View in full-text

Context 3

... pathways, the following routes of exposure were considered: (1) ingestion of surface water; (2) ingestion of fish; (3) vapor and particle inhalation at a hypothetical receptor point of exposure 305 m downwind of the landfill; and (4) child- hood ingestion of soil contaminated with waste particulates 305 m from the edge of the disposal unit (Fig. 1; Table 2). As discussed in Table 2 Exposure pathways and routes considered in DRAS and the associated cadmium benchmark values used in DRAS to calculate a hazard quotient (HQ) and carcinogenic risk. Section 2.2.1, the U.S. EPA has not determined an inhalation RfC for cadmium. Therefore, a non-carcinogenic risk for vapor and particle ...

View in full-text

Similar publications

Recovery of Valuable Materials and Methods for Their Management When Recycling Thin-Film CdTe Photovoltaic Modules

Article

Full-text available

- Dec 2021
-
- Anna Kuczyńska-Łażewska
- 
- Ewa Klugmann-Radziemska
-
- Agnieszka Witkowska

Due to the development of new photovoltaic technologies, there is a need to research new recycling methods for these new materials. The recovery of metals from photovoltaic (PV) modules would reduce the consumption of raw materials. Therefore, the development of recycling technologies for used and damaged modules of newer generations is important f...

View

Citations

... Minimizing dangerous gaseous emissions, the principal innovative particular of the suggested treatment lies in the total ejection of the emissions of HF and fluorinated organic compound degradation [12]. On the off chance that CdTe PV boards are discarded in landfills rather than reused, our evaluation recommends that a well-being hazard related with arranging utilized boards in landfills is distant at current CdTe board use rates [13]. Various specialized issues influencing sustainable power source research are likewise featured, alongside valuable connections between guideline strategy systems and their future possibilities [14]. ...

A Review of Solar Photovoltaic Power Utilizations in India and Impacts of Segregation and Safe Disposal of Toxic Components from Retired Solar Panels

Article

Full-text available

- Feb 2023
- INT J ENERG RES
- 
- P. Jayapradha
- 
- Debabrata Barik

Environmental impacts of electricity production through nonrenewable sources are greatly reduced by solar energy production through PV cells. The use of solar energy as an alternative to conventional methods is about to increase tenfold by the year 2050. This considerably increases the number of solar cell wastes for which the recycling processes are confronted with various issues due to the presence of hazardous materials like Al, lead, chromium, glass, silver, and ethylene vinyl. Different approaches for the disposal and segregation of these materials through mechanical, thermal, and chemical means are investigated in this review work. Since many countries have begun to implement mechanisms to deal with the destruction of solar PV (photovoltaic) panels, this evaluation will concentrate on the existing mechanisms and procedures. Existing mechanisms like landfilling, open dumping, and regulations and policies of the retired solar panel were discussed.

View

... Perovskite film with 500 to 1000 nm used to form this type of cells. It is low cost and recorded efficiency of 25.2% [10]. It is the latest method that applies in solar cell to develop electricity. ...

Performance and efficiency of different types of solar cell material -A review

Article

Full-text available

- Sep 2022
-
- J Dhilipan
-
- N Vijayalakshmi
- 
- D B Shanmugam
- 
- R Jai Ganesh
-
- S Muralidharan

View

... Perovskite film with 500 to 1000 nm used to form this type of cells. It is low cost and recorded efficiency of 25.2% [10]. It is the latest method that applies in solar cell to develop electricity. …

PEROSKOVITE RELEVANCE TO DOE, FIRST SOLAR,UTOLEDO, INFLATION REDUCTION FUNDED ACCELERATOR CONSORTIUM RECENTLY FORMED TO ADVACE US MADE CDTE PANELS
____

________________________ Insert- DOE support and infusion of millions into Toledo University, First Solar and National Renewable Energy Lab called the Consortium to fast track improved American made, non silicon based (China geopolitics,economics, forced labor, environmental degradation,import export imbalance, etc). Whole article and text of Toledo with peroskovite research.-----
https://www.energy.gov/articles/doe-launches-new-research-group-grow-americas-solar-industry

https://www.nrel.gov/pv/cadmium-telluride-photovoltaics-accelerator-consortium-solicitation.html

https://www.utoledo.edu/features/energy/Review of CADMIUM TELLURIDE ACCELERATOR CONSORTIUM-

https://www.utoledo.edu/research/pvic/This gives you the real time twitter announcements of events at the u from students, inventors etc. COOL

One would wish that this would be a safer solar panel and that cradle to cradle is addressed. Greater efficiency with peroskvite on light concrete reflective undersurface could mean on already degraded land, or it could mean deforestation with a concrete pad. Greater efficiency could mean you get more energy in the desert via the sand reflective surface, less New England Gray days, not in small town neighborshoods where deforestation impedes lowering CO2. Lesser danger f water contamination, increased efficiency and the sand as an already present light surface. Or it could mean deforestation in Wareham, more sand strip mining endangering the aquifer in a state expecting greater rainfall and more gray days. I have a daily report on rooftop panels' output so I see this in real time.Perhaps the best for citizens is the greater transparency on sourced materials, where your money goers, documented efficiencies etc, focus as we insist on cradle to cradle sustainability and prepay so no selling after 10 years or a give away with a tax write off after that and then install on the same frames, the next gen of FH panels that have greater output and need more battery storage. Will the grid update be sufficient? Will we go through all this again? Will CdTe now called CADTEL by First Solar be eliminated for a non- toxic semiconductor?

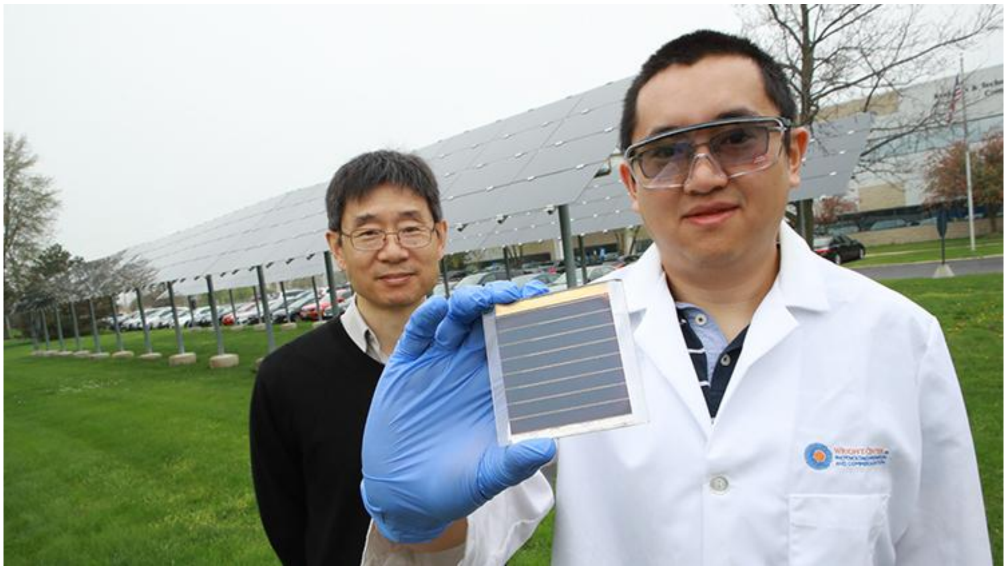
U.S. Department of Energy Invests in UToledo Solar Technology Research

November 2, 2021 | News, Research, UToday, Alumni, Natural Sciences and Mathematics

By Christine Billau

In the race against climate change, physicists at The University of Toledo are pushing the limits of solar electricity to ensure a clean energy future.

Through an innovative project that combines two types of solar cells and harvests light not only from the sun but also light reflected off the ground, researchers are creating technology to develop stronger and longer-lasting solar panels.



Dr. Zhaoning Song holds a perovskite solar cell minimodule he developed with Dr. Yanfa Yan. The higher-efficiency, lower-cost solar cell technology could revolutionize energy generation around the globe.

UToledo is a world leader in the investigation of an advanced material called perovskites, a compound material with a special crystal structure that can be used to create less expensive and highly efficient solar cells.

The U.S. Department of Energy awarded UToledo a one-year, $300,000 grant to advance research that could lead to the integration of promising perovskite solar cell technology into existing production lines for cadmium-selenide-telluride (CST)-based solar cells, maximizing the performance of thin-film tandem solar cells and reducing the costs of energy.

UToledo’s work aims to collect light from both the front and back faces of the solar panel while interconnecting layers of perovskites and CST cells on both the front and the back faces of the solar panel. UToledo has a patent pending on the technology called monolithic bifacial perovskite-CST tandem cell.

The team is led by Dr. Zhaoning Song, research assistant professor in the College of Natural Sciences and Mathematics, and Dr. Yanfa Yan, Distinguished University Professor of physics, who previously set the world record for the conversion of sunlight to electricity using perovskites and increased total electrical power generated by using two different parts of the sun’s spectrum.

“Based on theoretical calculation, the monolithic bifacial tandem design can boost the output power density limit of conventional CST solar modules by up to 50% with a light color concrete ground,” Song said. “Our proof-of-concept device demonstrated a greater than 25% conversion efficiency improvement.”

UToledo’s project is one of 40 across the country selected for funding by the U.S. Department of Energy Solar Technologies Office out of a total of nearly $40 million invested to advance the next generation of solar, storage and industrial technologies necessary for achieving the Biden administration’s climate goal of 100% clean electricity by 2035.

“We are laser focused on deploying more solar power and developing more cost-effective technologies to decarbonize our electricity system,” said Secretary of Energy Jennifer M. Granholm. “Research to develop stronger and longer-lasting solar panels is critical to addressing the climate crisis.”

Specifically, the projects will reduce the cost of solar technologies by increasing the lifespan of photovoltaic systems from 30 to 50 years, developing technologies that will enable solar to be used in fuel and chemical production.

“Northwest Ohio continues to play a leading role in shaping the national and global response to the crisis of climate change,” said U.S. Representative Marcy Kaptur, who serves as chair of the House Appropriations Subcommittee on Energy and Water Development. “The University of Toledo is on the front lines of this effort, and its work to advance next-generation solar technologies will play a critical part in delivering the affordable, reliable, low-emission energy we need for our success in the 21st century.”

—

Performance and efficiency of different types of solar cell material – A review

Article

- May 2022

-
- J. Dhilipan
-
- N. Vijayalakshmi
- 
- D.B. Shanmugam
- 
- R. Jai Ganesh
-
- S. Muralidharan

Owing to the rapid increase in industrialization and population, global energy demand is at an extreme, whereas traditional fossil fuels such as coal, natural gas and oil, etc. are quickly exhaust. It is predicted that in the next 200–300 years, fossil fuels, particularly oil, will be depleted. The alternative source of energy is renewable energy. Many households are converting to pure, renewable electricity sources as the cost of renewable energy begins to fall. Amongst which, residential solar is among the most accessible and abundant. Fossil fuels create toxic emissions that influence the quality of water, air and soil and are concerned about global warming, another justification for choosing solar energy. Solar energy has been produced from the sun and eliminates the hassle, confusion and cost of fueling a generator powered by gas or diesel. However some of the challenges that solar cells undergo are dependent on the nature of the materials and are especially susceptible, at even low concentrations, to chemical and structural deficiencies. Materials supply and production control to achieve low prices. Durability and material ageing at the level of solar cells and modules are also a concern, as this influences the technology's reliability and ultimately the cost. This review paper discusses the recent production of cells in direct to build the efficiency of various types of conventional solar cells more effective and comparative.

... Humans have historically not come into regular contact with Te, except for gold, copper and lead miners and refinery workers (Shie and Deeds, 1920). Human exposure to Te will likely increase through the 21st Century through two main factors: (1) burgeoning use of cadmium telluride solar panels for cleaner electricity generation (Marwede and Reller, 2012;Cyrs et al., 2014;Zeng et al., 2015;Ramos-Ruiz et al., 2017) and (2) expanding copper mining operations to meet electric vehicle production (Kavlak and Graedel, 2013;Elshkaki et al., 2016;Goldfarb et al., 2017;Calvo and Valero, 2021). ...

Natural nanoparticles of the Critical Element tellurium

- Apr 2022
- 
- Owen P. Missen
- Ella R. Lausberg
-
- Joël Brugger

- 
- Barbara Etschmann
- 
- Maria A.D. Rea

Tellurium (Te) is a Critical Element that is toxic to microorganisms and humans alike, most notably in its soluble oxyanionic forms. To date, the biogeochemical behaviour of Te in Earth's surface environment is largely unknown. Here, we report the discovery of elemental Te nanoparticles (Te NPs) in regolith samples using Single-Particle Inductively Coupled Plasma Mass Spectroscopy. Tellurium NPs were detected in both proximal and distal locations (bulk concentrations >4 ppm) relative to weathering Te ores. Synchrotron X-ray Fluorescence Mapping and X-ray Absorption Spectroscopy showed that bulk Te in the regolith is generally associated with Fe (oxyhydr)oxides and clay minerals, and mostly found in the oxidation states +IV and +VI. Although Te NPs account for less than 2 mole‰ of Te in our samples, their detection provides evidence for the active biogeochemical cycling of Te in surface environments. Te NPs are reactive and are likely to have formed in situ in distal samples, most likely via microbially-mediated reduction. Hence, the presence of Te NPs indicates the potential for release of toxic soluble forms of Te even in environments where most Te is "fixed" in forms such as Fe (oxyhydr)oxides that have low solubility and poor bioavailability.

View

... Hazard identification is the first stage during risk estimation. For this, various studies utilised hypothetical site with worst-case scenario conditions such as no leachate collection or groundwater monitoring, no landfill liner, open/exposed waste with exposure to rainwater and environment (Sinha et al., 2012(Sinha et al., , 2019Cyrs et al., 2014). Risk due to Cd and Pb exposure was mainly investigated because of their carcinogenic nature. ...

... For all scenarios, exposure point concentrations of Pb, Cd, and Se in groundwater and soil are below USEPA risk-based screening levels and maximum contaminant levels. Cyrs et al. (2014) Cd (CdTe) Screening level risk assessment using DRAS was done for panel disposal in landfill. ...

A state-of-art review on end-of-life solar photovoltaics

Article

- Feb 2022
- J CLEAN PROD
- 
- Preeti Nain
- 
- Arun Kumar

In last two decades, solar photovoltaic industry has shown tremendous growth among all renewable energy sectors, as a result, the concern of their end-of-life waste management increased. This study reviews the current state -of- art on end-of-life photovoltaics in terms of the materials used during manufacturing, their fate in environment, short-term & long-term leaching behaviour, applicability of current standard waste characterisation methods, possible human & ecological risk, manufacturers & consumers perspective towards management and recycling. A comprehensive comparative analysis of various findings from recent studies regarding the subject of end-of-life photovoltaic waste was done. Special emphasis was given on understanding the material release from first and second generation photovoltaics as per various theoretical and experimental studies to identify knowledge gaps. The findings from review shows that metals, such lead, copper, iron and aluminium have the potential to exceed hazardous waste limits, though a majority of them do not exceed the standard waste methods limit. Among the various modules, the highest material release was observed from crystalline-silicon modules. Further, if solar modules are disposed in landfills, the increase in leachate pollution index is mainly due to the leached heavy metals such as lead and chromium as the effect due to other parameters is negligible. At present, solar photovoltaics are generally grouped with electronic waste and is not classified under any waste category (hazardous or non-hazardous) except the United States of America and Europe. Amendments in existing waste characterization tests considering the complexity of photovoltaic waste and disposal mode should be considered. Further, as per various studies, progressing research is needed to establish standardized methods for recycling of photovoltaics. Present study gives a summary and future outlook on end-of-life solar photovoltaics with recommending the future directions for researchers and public policymakers.

View

... This means that unlike crystalline silicon modules, the cells cannot be separated from the panel simply through delamination of the encapsulant. A number of the elements which make up these cell types are toxic, in particular cadmium (present in both the CdTe absorber layer and in cadmium sulphide window layers), selenium (present in the CIGS absorber material) and tellurium (present in the CdTe absorber) [44,[70][71][72]. Recycling of these module types therefore has to include careful environmental controls in order to prevent accidental release of these materials [70]. ...

... A number of the elements which make up these cell types are toxic, in particular cadmium (present in both the CdTe absorber layer and in cadmium sulphide window layers), selenium (present in the CIGS absorber material) and tellurium (present in the CdTe absorber) [44,[70][71][72]. Recycling of these module types therefore has to include careful environmental controls in order to prevent accidental release of these materials [70]. A further complication with these types of module is that a number of the constituent materials are rare, experience high levels of demand, or both [34,45,71,73,74]. ...

Reshaping the Module: The Path to Comprehensive Photovoltaic Panel Recycling

Article

Full-text available

- Feb 2022
- Patrick J. M. Isherwood

The market for photovoltaic modules is expanding rapidly, with more than 500 GW installed capacity. Consequently, there is an urgent need to prepare for the comprehensive recycling of end-of-life solar modules. Crystalline silicon remains the primary photovoltaic technology, with CdTe and CIGS taking up much of the remaining market. Modules can be separated by crushing or cutting, or by thermal or solvent-based delamination. Separation and extraction of semiconductor materials can be achieved through manual, mechanical, wet or dry chemical means, or a combination. Crystalline silicon modules are currently recycled through crushing and mechanical separation, but procedures do exist for extraction and processing of intact wafers or wafer pieces. Use of these processes could lead to the recovery of higher grades of silicon. CdTe panels are mostly recycled using a chemical leaching process, with the metals recovered from the leachate. CIGS can be recycled through oxidative removal of selenium and thermochemical recovery of the metals, or by electrochemical or hydrometallurgical means. A remaining area of concern is recycling of the polymeric encapsulant and backsheet materials. There is a move away from the use of fluorinated backsheet polymers which may allow for improved recycling, but further research is required to identify materials which can be recycled readily whilst also being able to withstand outdoor environments for multi-decadal timespans.

View

... Humans have historically not come into regular contact with Te, except for gold, copper and lead miners and refinery workers (Shie and Deeds, 1920). Human exposure to Te will likely increase through the 21st Century through two main factors: (1) burgeoning use of cadmium telluride solar panels for cleaner electricity generation (Marwede and Reller, 2012;Cyrs et al., 2014;Zeng et al., 2015;Ramos-Ruiz et al., 2017) and (2) expanding copper mining operations to meet electric vehicle production (Kavlak and Graedel, 2013;Elshkaki et al., 2016;Goldfarb et al., 2017;Calvo and Valero, 2021). ...

Natural Nanoparticles of the Critical Element Tellurium

Article

- Jan 2022
- 
- Owen Missen
- Ella Lausberg
-
- Joël Brugger
-
- Barbara Etschmann
- 
- Maria A.D. Rea

View

... While CdTe and other thin-film technologies provide emission-free energy during operation, the heavy metals used in thin-film PV cells are expected to pose health and environmental risk during EoL disposal if not done scientifically [87]. Some manufacturers (e.g., First Solar) have developed recycling processes for CdTe, which are scalable commercially; however, for other thin films and third-generation PV materials, recycling technology is yet to reach maturity [55]. ...

Future of photovoltaic technologies: A comprehensive review

Article

- Oct 2021
- 
- Santosh Ghosh
- Ranjana Yadav

Link for free download https://authors.elsevier.com/a/1dIAb7tDQ9Gxkh
****
Presently, the world is going through a euphoric rush to install photovoltaic (PV) devices in deserts, over water bodies, on rooftops of houses, vehicles, and parking spaces, and many other applications. The cumulative PV installation is estimated to have crossed 600 GW globally to date and is expected to cross 4500 GW by 2050 due to sustained investment and continual innovation in technology, project financing, and execution. This article presents a critical and comprehensive review of the wide spectrum of present and future PV technologies, not only in terms of their performance but also in terms of the aspects of their end-of-life waste management and ecotoxicity, which have been largely neglected by the researchers and policymakers. The global status of the regulatory framework is reviewed as well, with regard to the life cycle management of PV waste. And It is found that presently, the world is very poorly equipped with regulatory frameworks to deal with massive PV waste (about 78 million tonnes), expected to be generated by 2050. Based on the findings, an immediate and disruptive paradigm shift is proposed in the policy framework, from the promotion of new PV installation to life cycle management of PV assets.

View

... Devices are based on films of copper, gallium diselenide (CIGS) and cadmium telluride (CdTe) indium as well as thin layers of amorphous silicon (a-Si). Some problems related to the high toxicity of specific materials, such as cadmium, limit their use on a large scale [3,4]. ...

Direct growth and size tuning of InAs/GaAs quantum dots on transferable silicon nanomembranes for solar cells application

Article

Full-text available

- Jul 2021
- J MATER SCI-MATER EL
- Mansour Aouassa
- 
- Giorgia Franzò
- 
- Ridha M’Ghaieth
- 
- Hassen Chouaib

In this paper we show for the first time the possibility to direct grow and tune the size and optical properties of high quality InAs/GaAs quantum dots on transferable crystalline silicon nanomembranes. The transferable silicon nanomembranes have been grown via in-situ H2 prebake of porous silicon in Ultra High Vacuum Chemical vapour Deposition (UHV-CVD) reactor. Flat and continuous transferable crystalline nanomembranes with thicknesses below 30 nm have been obtained. The mechanical strain in the silicon nanomembranes has been tuned via sintering temperature between 900 and 1100 °C for the direct crystalline growth of transferable InAs/GaAs (QDs)/Si foils. The size and band gap energy of these InAs/GaAs quantum dots are tuned via strain engineering in silicon nanomembranes. Several advanced techniques such as Scanning Electron Microscopy (SEM), High-Resolution Transmission Electron Microscopy (HR-TEM), X-Ray Diffraction (XRD), Photoluminescence (PL) spectroscopy are used to investigate the structural and optical properties of transferable silicon nanomembranes and the grown InAs/GaAs QDs. High quality InAs/GaAs QDs with tuned sizes grown on flat and continuous transferable crystalline nanomembranes have been obtained. The obtained results have shown that this novel process allows the growth of well separated InAs/GaAs QDs with well defined shape, high density around 2 × 1010/cm2 and a well controlled size variation as function of the substrate strain between 2 and 10 nm. The high quality of the structural and optical properties of the InAs/GaAs QDs monolithically grown on a transferable Si nanomembranes and its compatibility with standard Si solar cells technologies offer a great opportunity for growing a cheap and high performance InAs/GaAs quantum dots/Si third generation solar cells and microelectronic devices.

View

... Boiling of elemental Se during production of electronic devices leads to atmospheric pollution, as well as release from improperly sealed landfills (Diplock and Kurzer 1974). Selenium is also used in the production of photovoltaic batteries and photometers; recycling of these components is far from complete, and there remains uncertainty about leaching of Se and other metals from landfills (Cyrs et al. 2014). Compounds formed from selenides can be used as metal lubricants, to enhance stainless steel machinability, to increase the abrasive resistance in rubber, and as a print photography toner. ...

Selenium Contamination in Water

Book

- May 2021
- 
- Pooja D. Sharma
- 
- Pardeep Singh
- 
- Arindam Malakar
- 
- Daniel Snow

The contamination of environment and water resources by Selenium (Se) and its oxyanions from various sources are emerging contaminants of significant health and environmental concern. The primary sources include agricultural drainage water, mine drainage, residues from fossil fuels, thermoelectric power plants, oil refineries, and metal ores. Various methods and technologies have been developed which focus on the treatment of selenium-containing waters and wastewater. High concentrations of selenium in water cause various adverse impact to human health, such as carcinogenic, genotoxic, and cytotoxic effects. But in the lower concentrations, it is a useful constituent of the biological system. The range between toxicity and deficiency of selenium is minimal (40 to 400 μg per day), due to its dual nature. Selenium Contamination in Water contains the latest status and information on selenium's origin, its chemistry and its toxicity to humans. The book represents a comprehensive and advanced reference book for students, researchers, practitioners, and policymakers in working in the field of metalloids, in particular selenium. A special emphasis is given on its geological distribution, monitoring techniques, and remedial technologies. As such, the authors critically analyze the various techniques used for the monitoring and removal of selenium from water. Featuring chapters arranged according to the major themes of the latest research, with specific case-studies from industrial experiences of selenium detection and removal, Selenium Contamination in Water will be particularly valued by researchers, practitioners, and policymakers in working in the field of metalloids including selenium.

View

Show more