“While PVF represents a small portion of microplastics discovered in the environment, fluoropolymer microplastics may further contribute to environmental, groundwater, produce or landfill PFAS levels without the necessary SOURCE CONTROL.” Water Online- Guest Column | April 13, 2021

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# **The Microplastics And PFAS Connection**

By Cayla Cook and Eva Steinle-Darling

Dear Planning Board,

I have represented the above science in prior documents as evidence of the need to know the coatings on solar panels- Anti-reflective and hydrophobic- that are not spoken of by developers. They are crowed about in manufacturers’ representations of the panels they produce for maintaining and amping power, yet silent about their constituent materials and their possible degradation/movement into our soils and water. I am concerned about the coatings applied before nanoparticle technology, and now learn nanoparticles have been used for some time. As with our water bottles, solar panel production looks to be advancing to a whole unknown of alarming consequences with nanoparticles.

If the 1000 times more nanoparticles of plastic in one plastic bottle of water worries you, nanoparticle chemicals used in coatings on the hundreds of thousands of panels over Wareham’s Sole Source Aquifer would give you pause.

I believe we would be derelict to permit or allow extensions extensions for any solar utility including Makepeace projects without knowing more about these applications. The New Leaf/Borrego developers have said they will use Hanwha and JA panels, adding after other panels have been mentioned and discarded, that they won’t know and can’t say what panels they are using until construction begins. We therefore “can’t” know their coatings.

That would be AFTER the permitting has been given without this critical information.

The following is an addendum to to the photo-essay I sent last year after the DEP site visit to Fearing Hill. It was written to Jaclyn Sedman after this month’s site visit and in light of last month’s nanoparticles -news explosion and my learning of nanoparticle chemicals in solar panel Hydrophobic Coatings and Anti- Reflective Coatings. I have expressed concern for a these coatings to the Board for a good while. Here I give a broad brush picture of serious new concerns to study for protection of our health safety and welfare in permitting.

Would that we had all listened and learned earlier of concerns about PFAS which have now been detected in our water.Sincerely, Annie

Annie Hayes

52 Farmer’s Lane Fearing Hill

West Wareham,

Mass. 02576

Dear Jaclyn,

Thank you for your respect and warmth. You gave me the feeling that you are working with local citizens who know the land, have fostered it for lifetimes and who know there is a better situating of necessary solar energy ( I have three rooftop arrays) than in the destruction of a forested watershed that has provided shelter, beauty, life sustenance, and habitat for so many beings including the ancient Wampanoag tribe who rested on Fearing Hill peak. Each spring they traveled the Ancient Way from East Freetown to the overlook of their Summer Place looking out over the great abundance of the Sippican and Weweantic Riverways to the plenty and comfort stretching to Buzzards Bay.

To their Summer home, Nippenae Kekkit.

Nanoplastics

Nanoparticles -what they are and the danger they present to living beings.

Nanoparticles in Solar Technology- Anti-Reflective Coatings and Hydrophobic Coatings. And Expanding.

The most recent study by Columbia and Rutgers Universities published in the Proceedings of the National Academy of Sciences (January 2024) found that in a typical liter of bottled water there were 240,000 plastic fragments. Of these, 10% were microparticles (5 millimeters to 1 micrometer), and 90% were nanoparticles (less than 1 micrometer). [https://www.nih.gov/news-events/nih-research-matters/plastic-particles-bottled-water#:~:text=The%20researchers%20found%20that%2C%20on,mostly%20focused%20on%20larger%20microplastics.](https://www.nih.gov/news-events/nih-research-matters/plastic-particles-bottled-water#:~:text=The%20researchers%20found%20that%2C%20on,mostly%20focused%20on%20larger%20microplastics)



## [Science of The Total Environment](https://www.sciencedirect.com/journal/science-of-the-total-environment)

[Volume 906](https://www.sciencedirect.com/journal/science-of-the-total-environment/vol/906/suppl/C), 1 January 2024, 167404



# Emergence of nanoplastics in the aquatic environment and possible impacts on aquatic organisms

Author links open overlay panel

Chaoli Shi a, Zhiqun Liu a, Bingzhi Yu a, Yinan Zhang a, Hongmei Yang a, Yu Han a, Binhao Wang a, Zhiquan Liu a b, Hangjun Zhang a c

<https://doi.org/10.1016/j.scitotenv.2023.167404>[Get rights and content](https://s100.copyright.com/AppDispatchServlet?publisherName=ELS&contentID=S004896972306031X&orderBeanReset=true)

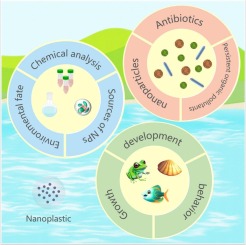
## Highlights

* •  
  Research on nanoplastic toxicity to aquatic organisms analyzed via bibliometrics.
* •  
  Sources, chemical analysis, and environmental fate of nanoplastic were discussed.
* •  
  Comprehensive assessment of nanoplastic toxicity through various mechanisms.
* •  
  Investigating toxic effects of combined exposure to three pollutants and nanoplastic.
* •  
  Emphasizing implications for risk assessment and future research.

## Abstract

Plastic production on a global scale is instrumental in advancing modern society. However, plastic can be broken down by mechanical and chemical forces of humans and nature, and knowledge of the fate and effects of plastic, especially nanoplastics, in the aquatic environment remains poor. We provide an overview of current knowledge on the environmental occurrence and toxicity of nanoplastics, and suggestions for future research. There are nanoplastics present in seas, rivers, and nature reserves from [Asia](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/asia), Europe, [Antarctica](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/antarctic-region), and the [Arctic Ocean](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/arctic-ocean) at levels of 0.3–488 microgram per liter. Once in the aquatic environment, nanoplastics accumulate in plankton, [nekton](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/nekton), [benthos](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/benthos) through ingestion and adherence, with multiple toxic results including inhibited growth, reproductive abnormalities, [oxidative stress](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/oxidative-stress), and immune system dysfunction. Further investigations should focus on chemical analysis methods for nanoplastics, effect and mechanism of nanoplastics at environmental relevant concentrations in aquatic organisms, as well as the mechanism of the Trojan horse effect of nanoplastics.

## Graphical abstract



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## Introduction

The widespread use and reliance on plastics in various industries across the world is a testament to their significance. Plastics provide safe and durable packaging (Sangroniz et al., 2019), and are used to manufacture lightweight components for vehicles and electronic devices, insulate buildings, enhance agricultural practices, create functional clothing, and produce a wide range of consumer products (Lau et al., 2020). Plastics, as synthetic organic polymers composed of long chain-like molecules with high molecular weight, have been in development since the mid-nineteenth century. During the early twentieth century there were significant advances in plastic production (Law, 2017). The momentum of commercial plastic production further surged during World War II, leading to exponential growth in global plastics production. By 2019, use of plastics had reached an astounding 460 million metric tons (OECD, 2022a). And by 2060, leakage of plastics into the aquatic environment is projected to reach 509 million metric tons (OECD, 2022b). Due to the extensive use of plastic products and limited production control, plastic waste is discharged into the aquatic environment and has become of growing environmental and public health concern (Syberg et al., 2021; van Emmerik and Schwarz, 2020).

Plastics undergo various degradation processes in aquatic environments, leading to their fragmentation into smaller particles commonly referred to as “nanoplastics” (Kung et al., 2023). There is currently debate over the term “nanoplastics,” which generally refers to plastic particles of diameter <100 nm, while some scholars set the upper limit at 1000 nm and believe that nanoplastics are particles of 1–1000 nm produced from the degradation of industrial plastic objects, exhibiting colloidal behavior (Gigault et al., 2018). The definition adopted in this article is that microplastics have particle sizes of range 1–5 μm, while nanoplastics have particle sizes below 1000 nm. After the outbreak of the COVID-19 pandemic, the demand for disposable plastic products like masks and gloves surged dramatically (Liang et al., 2022). The fiber microstructure of disposable surgical masks can undergo aging and cause changes in crystallinity when exposed to direct sunlight, leading to a new form of plastic waste in aquatic ecosystems (De-la-Torre et al., 2022; Schirinzi et al., 2020; Impellitteri et al., 2023a; Gokul et al., 2023a; Gokul et al., 2023b; Burgos-Aceves et al., 2021). It has increased the release of microplastics/nanoplastics (183 to 1247 particles piece−1) and organic pollutants from land and water bodies (Mohamed et al., 2022). Surgical masks have emerged as a potent nanoplastics source, further exacerbating the issue of plastic pollution.

In addition, the concomitant effects of global warming, amplified precipitation, and turbulent wind patterns have led to a substantial influx of plastic and microplastics debris into aquatic ecosystems, threatening the survival of aquatic organisms (Zhang et al., 2020). Nanoplastics have significant toxicity potential, for example, common carp (*Cyprinus carpio*) (Hamed et al., 2022) and largemouth bass (*Micropterus salmoides*) (Chen et al., 2022) are susceptible to the toxic biological effects of nanoplastics. As assumed food sources of plankton, microplastics and nanoplastics can easily enter the aquatic food chain through ingestion, transport, and accumulation from lower to higher trophic levels, infiltrating and aggregating in the cells and tissues of aquatic organisms and disrupting their metabolism and reproduction (Dong et al., 2023; Li et al., 2021a; Banaee et al., 2023; Porretti et al., 2023). The toxic effects may stem from the original nanoplastics, such as the size of plastic particles and the type of surface functional groups, or may come from hydrophobic water pollutants that are adsorbed onto smaller-sized nanoplastics from ambient water (Xin et al., 2023; Aynard et al., 2023; Liu et al., 2023). Compared to the environmental issue of “white pollution” caused by plastic waste, the harm of nanoplastics is mainly reflected in their very small size, which may cause deeper damage to organisms (Nolte et al., 2017).

Currently, the investigation of nanoplastic's toxic effects on organisms involves various methodologies such as toxicology, molecular biology, transcriptomics, metabolomics, and proteomics (Liu et al., 2018; Liu et al., 2020a; Liu et al., 2021a; Grodzicki et al., 2021; Feng et al., 2022; Li et al., 2023a). Researchers are exploring the cellular and molecular levels to understand the toxic impacts of nanoplastics on plankton (Kokalj et al., 2023), nekton (Xu et al., 2023), benthos (Li et al., 2022a). However, the current focus of research primarily revolves around summarizing the uptake, accumulation, and transport patterns of nanoplastics in organisms, with limited attention given to systematically categorizing and summarizing their toxic effects on organisms, including oxidative stress, inflammation, metabolic disorders, and genotoxicity (Burgos-Aceves et al., 2018; Gangadoo et al., 2020; Ramasamy and Palanisamy, 2021).

Additionally, there is a need to investigate the mechanisms and interactions of nanoplastics with other pollutants (Oriekhova and Stoll, 2018; Ter Halle and Ghiglione, 2021).

This review comprehensively summarizes the relevant literature across years, selecting high impact-factor literature for analysis and comparison against similar research findings, focuses on nanoplastics, and summarizes the pollution status of nanoplastics, the toxic effects of waterborne nanoplastics, and the effects of nanoplastics on growth, development, and behavior of aquatic organisms. This study emphasizes the analysis and exploration of the toxic effects of nanoplastics on aquatic organisms under different conditions, and further develops the environmental risk assessment of nanoplastics, providing reference values for future researchers to study nanoplastics biotoxicity in depth.”

[RETURN TO ISSUE](https://pubs.acs.org/toc/esthag/54/21)[PREV](https://pubs.acs.org/doi/10.1021/acs.est.0c02901)TREATMENT AND RESOUR...[NEXT](https://pubs.acs.org/doi/10.1021/acs.est.0c03968)

# **Nanoplastics Disturb Nitrogen Removal in Constructed Wetlands: Responses of Microbes and Macrophytes**

[Cite this:](https://pubs.acs.org/action/showCitFormats?doi=10.1021%2Facs.est.0c03324&href=/doi/10.1021%2Facs.est.0c03324) *Environ. Sci. Technol.* 2020, 54, 21, 14007–14016

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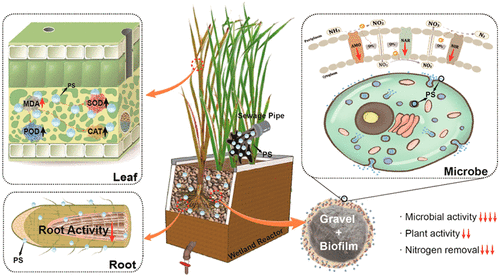
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## 



[Environmental Science & Technology](https://pubs.acs.org/est)

## **Abstract**

****

Nanosized plastics (nanoplastics) releasing into the wastewater may pose a potential threat to biological nitrogen removal. Constructed wetland (CW), a wastewater treatment or shore buffer system, is an important sink of nanoplastics, while it is unclear how nitrogen removal in CWs occurs in response to nanoplastics. Here, we investigated the effects of polystyrene (PS) nanoplastics (0, 10, and 1000 μg/L) on nitrogen removal for 180 days in CWs. The results revealed that total nitrogen removal efficiency decreased by 29.5–40.6%. We found that PS penetrated the cell membrane and destroyed both membrane integrity and reactive oxygen species balance. Furthermore, PS inhibited microbial activity *in vivo*, including enzyme (ammonia monooxygenase, nitrate reductase, and nitrite reductase) activities and electron transport system activity (ETSA). These adverse effects, accompanied by a decline in the relative abundance of nitrifiers (e.g., *Nitrosomonas* and *Nitrospira*) and denitrifiers (e.g., *Thauera* and *Zoogloea*), directly accounted for the strong deterioration observed in nitrogen removal. The decline in leaf and root activities decreased nitrogen uptake by plants, which is an important factor of deterioration in nitrogen removal. Overall, our results imply that the presence of nanoplastics in the aquatic environment is a hidden danger to the global nitrogen cycle and should receive more attention.

Given this recent and increasingly alarming research on the influence of plastics and coatings that are used on panels, it is essential that we know the make, model and chemical composition of all layers and materials within the panel. To date, Developers refuse this information, saying they will not know the panel they will use until construction begins. This is wrong. Our water is our health, safety and welfare and in this sense the wetlands are the canary in the coal mine. Panels must be a totally known material as they will sit in our watershed environment draining and potentially leaching for up to 40 years (the lease extensions allowed) in increasingly severe weather intensities and fluctuations that we cannot possibly predict except to say that it is sixty degrees in the first week of march, 2024. National Flood Insurance is slowly weaning coastal residents off their bankrupt flood insurance subsidies. Communities with degraded and uprooted hillside forests are causing flooding with silt laden waters destroying plants, land,water bodies and pathways,homes and wells.

[Home](https://www.millburysutton.com/)[News](https://www.millburysutton.com/category/news/)Douglas ConCom Fines Oak Hill Solar Farm Developers**Douglas ConCom fines Oak Hill solar farm developers**

* JANUARY 18, 2024
* [NEWS](https://www.millburysutton.com/category/news/)

By Melissa McKeon, Millbury Sutton Chronicle

DOUGLAS — The developers of a solar farm on Oak Street in Douglas that is under construction and responsible for silt runoff into waterways in Douglas and Sutton are being fined $200 a day until plans to solve the problem are implemented.

Oak Hill is also being fined $300 a day by the town of Sutton for the runoff. The town of Sutton’s fine is for 90 days from the implementation of the fine on December 20. It can be lifted at any time or continued.

Heavy rain on two occasions in December caused runoff onto properties surrounding the solar farm development, and from there into waterways in Sutton, including Manchaug Pond and Stevens Pond.

The developers have submitted remediation plans to both towns for the silt spillage, including vacuuming spillage and testing the runoff. The town of Douglas added PFAS to the elements to be tested.

Abutters whose properties have been impacted by the runoff spoke at meetings in both Sutton and Douglas.

While the developer is taking actions to prevent and clean up silt runoff, the Douglas meeting yielded some bad news for abutters: it is highly unlikely that, even with the project completed, the water flowing in the area will be the same as it was before the solar farm project began.

We are told by developers we can’t know the make and model thus the coatings- of panels they will install by the thousands. Wareham has possibly hundreds of thousands by now. They say they won’t know until installation, virtually asking us, sight unseen, materials unknown, toxicity undetermined , to life with 24/7 weather washing, pummeling and heating and freezing these materials with constant UV light and potential degradation of sealants, cracking, blistering, moisture intrusion etc. occurring. What other industry would get away with putting that product over our sole source of water and private wells not using public water, of which there are many affected by the Fearing Hill Watershed.

Regarding Anti-Reflective Coating- Solar Industry reads like this

# “What is TiO2 coating?

TiO2 is a titanium dioxide-based coating that helps solar panels to keep clean and absorb as much light as possible. The titanium dioxide in the coating reacts to UV light and attacks any microbes that are present on the panel which prevents fungal growth, organic build up and even pollution deposits. Titanium dioxide also has anti-reflective properties, assisting in sunlight absorption.”

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##### TRUSTED INDUSTRY EXPERTS”

* Science reads like this-
* New Jersey Hazardous Materials-Titanium Dioxide may be a CARCINOGEN in humans. There may be no safe level of exposure to a carcinogen, so all contact should be reduced to the lowest possible level. TITANIUM DIOXIDE Page 2 of 6 For each individual hazardous ingredient, read the New Jersey Department of Health Hazardous Substance Fact Sheet.Cancer Hazard Titanium Dioxide may be a CARCINOGEN in humans since it has been shown to cause lung cancer in animals. Many scientists believe there is no safe level of exposure to a carcinogen. Such substances may also have the potential for causing reproductive damage in humans. Reproductive Hazard According to the information presently available to the New Jersey Department of Health, Titanium Dioxide has not been tested for its ability to affect reproduction.
* [The performance and durability of Anti-reflection coatings for solar module cover glass – a review - ScienceDirect](https://www.sciencedirect.com/science/article/pii/S0038092X23004061)
* The materials and deposition methods used for such coatings are reviewed and a discussion around the durability of anti-reflection coatings is presented, with recent work showing that the current industry standard- porous silica coatings are vulnerable to abrasion, as well as chemical thinning and humidity-related degradation. These coatings are also hydrophilic with high surface energy and greater adhesion to soiling. Multilayer coatings consisting of alternate layers of dielectric metal oxides such as ZrO2 and SiO2 are highlighted as potential alternatives to porous SiO2. The development of an abrasion standard for solar module coatings is also discussed. Suggestions for the future direction of the field are provided, including multifunctionality, such as hydrophobicity for anti-soiling, and sub-bandgap reflection for passive cooling.

Third-Generation Solar Cells: Toxicity and Risk of Exposure

Elina Buitrago,a, b Anna Maria Novello,a, b and Thierry a

Ecole Polytechnique Fédérale de Lausanne (EPFL), Safety Competence Center (DSPS-SCC), Station 6, CH-1015

Lausanne, Switzerland

bEcole Polytechnique Fédérale de Lausanne (EPFL), Group of Chemical and Physical Science “Solar energy is considered clean energy, and its use is predicted to increase in the near future. Most installed units today are crystalline solar cells, but the field is in constant development, and when the first dye sensitized solar cell was published by *Grätzel* and *O'Reagan* a new, third-generation, solar power was born. Highly toxic metals are used to produce the photovoltaic units today, and with the predicted increase in solar cell installation, the human health hazards of these panels could become an issue. Additionally, many of these materials are used in their NANOFORM, which is associated with an additional risk. In this article, we discuss the technology behind the third-generation solar cells with its valuable use of nanotechnology as well as the solar power units. We will show that the main exposure will occur either during the possible health hazard when such nanomaterials are used development and production phases or at the end-of-life stage of the solar cells, where toxic material can leach into landfills, and subsequently into the environment and impact the ecosystem directly, or humans indirectly through edible plants or drinking water.

( And from /degradation/runoff of ARC and Hydrophobic coatings on panels?)

* [NANOTECHNOLOGY AND HEALTH RISKS](https://www.env-health.org/IMG/pdf/17-_NANOTECHNOLOGY_AND_HEALTH_RISKS.pdf)
* What is “nanotechnology” and how is it used? Health & Environment Alliance (HEAL) FACT SHEET 2 discuss their high chemical reactivity and their greater capacity to penetrate biological membranes also pose serious new toxicity risks.

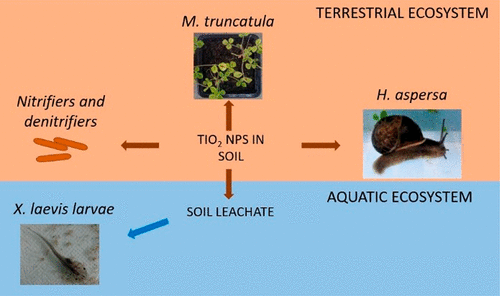
# **SeTransfer and Ecotoxicity of Titanium Dioxide Nanoparticles Terrestrial and Aquatic Ecosystems: A Microcosm Study**

# [Cite this:](https://pubs.acs.org/action/showCitFormats?doi=10.1021%2Facs.est.8b02970&href=/doi/10.1021%2Facs.est.8b02970) *Environ. Sci. Technol.* 2018, 52, 21, 12757–1276 Publication Date:October 17, 2018

<https://doi.org/10.1021/acs.est.8b02970> Copyright © 2018 American Chemical Society

[Environmental Science & Technology](https://pubs.acs.org/est)

## **Abstract**

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With the advancement in nanotechnology, particularly the use of TiO2 nanoparticles (NPs), there is a need to study their release into the environment and assess the related risk in an environmentally relevant contamination scenario. In the present study, the transfer and toxicity of TiO2 NPs in microcosms mimicking terrestrial and aquatic ecosystems were evaluated. The contaminated soil was prepared by spiking natural soils, with these then used as the basis for all exposure systems including preparation of soil leachates for amphibian exposure. Results demonstrated significant reductions in bacterial (−45%) and archaeal (−36%) nitrifier abundance; significant translocation of Ti to *M. truncatula* leaves (+422%); significant reductions in plant height (−17%), number of leaves (−29%), and aboveground biomass (−53%); nonsignificant Ti uptake in snail foot and viscera, and excretion in feces; and genotoxicity to *X. laevis* larvae (+119% micronuclei). Our study highlights a possible risk of engineered TiO2 NPs in the environment in terms of trophic transfer and toxicity in both terrestrial and aquatic environments.

# Nano-pollution: Why it should worry us

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Nelofer Jan, Neelofar Majeed, Muneeb Ahmad, Waseem Ahmad Lone, Riffat John

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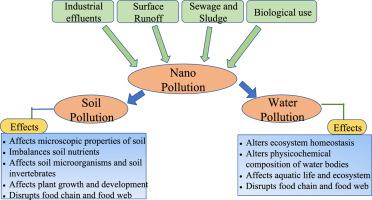
## Highlights

* •  
  Carbon nanoparticles (NPs) have an adverse effect on different plants, animals and human health.
* •  
  ZnO nanoparticles are considered as one of the most commonly used nanomaterials.
* •  
  Plants are critical elements of all habitats, and the impact assessment of NPs on flora is extremely important to consider..
* •  
  More research into the effects of NPs on community and ecological structure is the need of hour.

## Abstract

[Nanoparticles](https://www.sciencedirect.com/topics/earth-and-planetary-sciences/nanoparticle) are immensely diverse both in terms of quality and sources of emission into the environment. Nowadays, nanotechnologies are developing and growing at a rapid pace without specific rules and regulations, leading to a severe effect on environment and affecting the labours in outdoor and indoor workplaces. The continue and enormous use of NPs for industrial and commercial purposes, has put a pressing need to think whether the increasing use of these NPs could overcome the severe environmental effects and unknown human health risks. Only a few studies have been carried out to assess the toxic effect of these NPs resulting from their direct or indirect exposure. There is in an increasing clamour to consider environmental implications of NPs and to monitor the outcome of NP during use in biological testing. There remain many open questions for consideration. An adequate research is required to determine the real toxic effect of these NPs on environment and human health. In this review, we have discussed the negative effects of NPs on environment and biosphere at large and the future research required.

## Graphical abstract



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* [Download : Download full-size image](https://ars.els-cdn.com/content/image/1-s2.0-S0045653522012395-ga1.jpg)

## Introduction

Nanoparticles (NPs) are the materials having a size of less than 100 nm with a varied shape -tubular, spherical, dendritic, rods, flakes and platelets (Gao et al., 2015). NPs have existed on Earth for millions of years and are present in the environment as airborne nanocrystals of sea salts, biogenic, fullerenes, carbon nanotubes and magnetite (Taghavi et al., 2013; Nowack and Bucheli, 2007). The primary major sources contributing towards the formation of naturally occurring nanoparticles are high-temperature volcanic ash plumes, outlets of underwater volcanoes from deep-sea hydrothermal vents, fine soils and sediments and aerosol formation from sea sprays (Hochella et al., 2012). Moreover, areas wherein different elements are present under low-temperature environmental conditions and in supersaturation, are believed to possess large quantities of nanoparticles (Banfield and Zhang, 2001). The alteration in physical and chemical conditions usually contributes towards the supersaturation of elements which in turn leads to the accumulation of inorganic nanoparticles. For example, evaporation of soil solutions, change in pH of neutral water by addition of acidic solutions, and incursion of Fe(II)-rich hydrothermal vent fluids (Banfield and Zhang, 2001). The anthropogenic NPs come from diesel and vehicle fuel combustion, various industrial processes and household fuels (Bouyahya et al., 2022). They can be either natural or synthetic, and can be organic or inorganic based on their chemical composition (Taghavi et al., 2013). Inorganic NPs can be metals (Au, Al, Ag, Bi, Cu, Co, In, Ti, Fe, Sn, Mo, Ni, Si, Zn, W), metal oxides (CuO, Al2O3, CeO2, Cu2O, La2O3, In2O3, NiO, SiO2, MgO, SnO2, ZrO2, ZnO, TiO2) or quantum dots. These metal and metal oxide NPs are synthesized from different biological species and are widely used in various biomedical fields and industries (Singh et al., 2018) (Table 1). Metal-based NPs (TiO2, Ag, CuO, FeO, ZnO) being widely used are highly toxic on diversity and abundance of flora and fauna (You et al., 2018; McGee et al., 2017; Ebbs et al., 2016).

NPs are widely used in agriculture industry, chemical industry, consumer products, coatings, optics and electronics, cosmetics, food industry, medical industry, textile industries, plastics, paints, fuel additives, wastewater treatment and environmental remediation (Rajput et al., 2018; Servin et al., 2017). NPs being continuously produced and utilized, the consumer products based on nanotechnology and online database have reported that more than 600 products and 2870 products contain NPs, respectively (Hansen et al., 2016). Use of NPs in biology and medicine has been reported to be US$17.5 billion in 2011 with an increased value of US$53.5 billion in 2017 and reaching US$79.8 billion in 2019 (Soni et al., 2015). Silver NPs are consumed at a rate of 450 tons per year with a production of Zinc NPs 5500 tons per year (McGillicuddy et al., 2017; Connolly et al., 2016).

Pollution caused by NPs (nano-pollution) also referred to be an “invisible pollution” is considered as the most serious pollution to be controlled and managed (Gao et al., 2015).

The nano-pollution is very dangerous because of its very small size, and can easily penetrate plant and animal cells, even through the skin leading to serious effects. NPs being used in a wide range of products with diverse applications increase the environmental pollution (Rajput et al., 2018).

NPs being released into the air, water and soil pose a serious threat owing to their small size. They can float easily into the air and get transported through water into the soil, and then get accumulated from plants into humans through food chain, causing a deleterious effect on humans (Fig. 1) (Rajput et al., 2018; Tripathi et al., 2012).

They can directly interact with the plants via foliar parts and can affect their growth, development, biochemical and physiological processes (Rico et al., 2015). CuNPs being used as bactericide and fungicide in agriculture is highly toxic to aquatic life (Zuverza-Mena et al., 2015).

Nano-pollution causes several disorders in humans, environmental instability and disturbs the whole ecosystem. The prolonged human exposure to NPs causes severe heart diseases, lung diseases and can lead to premature death (Pui et al., 2014). They cause pulmonary inflammations in humans inhaling the NP contaminated air (Bouyahya et al., 2022).

This increase in the production and concentration of NPs in the environment leading to nano-pollution has become a matter of concern. Hence, in the present review, we focus on the threats caused by toxicity of various NPs on soil and aquatic environment, microflora and fauna, and its perspective and scope in future.”

Regarding degradation of both hydrophobic and anti-reflective coatings, developers who refuse to discuss these coatings or say there is nothing in a solar panel that would cause permit refusal (even as these topics are refused discussion) might want to know we’ve read these articles. We must educate ourselves. They present what they want.

Performance and Durability Of Anti-Reflective Coating for Solar

<https://www.sciencedirect.com/science/article/pii/S0038092X23004061#b0065>

The durability of hydrophobic anti-soiling coatings has also been tested, with multiple studies showing poor abrasion resistance and UV stability [[75]](https://www.sciencedirect.com/science/article/pii/S0038092X23004061#b0375), [[76]](https://www.sciencedirect.com/science/article/pii/S0038092X23004061#b0380), resulting in loss of performance by either lowering of the WCA, resulting in a [hydrophilic coating](https://www.sciencedirect.com/topics/engineering/hydrophilic-coating), or coating removal. Anti-soiling functionality is a significant requirement for PV module coatings but an in-depth analysis is outside the scope of this review. Other review papers cover this area adequately, for both the fundamental problem of soiling and its impact in on PV module performance, as well as the development of anti-soiling coatings [[13]](https://www.sciencedirect.com/science/article/pii/S0038092X23004061#b0065), [[77]](https://www.sciencedirect.com/science/article/pii/S0038092X23004061#b0385), [[78]](https://www.sciencedirect.com/science/article/pii/S0038092X23004061#b0390). However, the emphasis here is that the development of coating with a combination of durable anti-reflection and hydrophobic anti-soiling functionality is

urgently needed.

[The performance and durability of Anti-reflection coatings for solar module cover glass – a review - ScienceDirect](https://www.sciencedirect.com/science/article/pii/S0038092X23004061)

The materials and deposition methods used for such coatings are reviewed and a discussion around the durability of anti-reflection coatings is presented, with recent work showing that the current industry standard porous silica coatings are vulnerable to abrasion, as well as chemical thinning and humidity-related degradation. These coatings are also hydrophilic with high surface energy and greater adhesion to soiling. Multilayer coatings consisting of alternate layers of dielectric metal oxides such as ZrO2 and SiO2 are highlighted as potential alternatives to porous SiO2. The development of an abrasion standard for solar module coatings is also discussed. Suggestions for the future direction of the field are provided, including multifunctionality, such as hydrophobicity for anti-soiling, and sub-bandgap reflection for passive cooling.

Panels have to be washed. How much water, whose water from where, additives for cleaning, equipment, frequency, soil compacting.? No one has mentioned that.

# **Feed detail update**

[2mo •](https://www.linkedin.com/in/omkarrmhatre?miniProfileUrn=urn%3Ali%3Afs_miniProfile%3AACoAAD4nPrkBQfOjuHhgq8oeCZmfZxt-zh2-ANk)

Follow

What Is ARC For Solar Panels? How to Protect ARC?

Anti-reflective coating, also known as AR coating, is a specialized layer applied to the surface of solar panels to enhance their efficiency by reducing unwanted reflection and increasing light transmission. It works by minimizing the loss of sunlight due to reflective losses, allowing more light to be absorbed by the solar cells. This ultimately leads to higher energy conversion efficiency and improved overall performance of the solar panel system.

📌Chemical Compositions:

AR coatings are typically composed of a thin film of transparent material that possesses low refractive index properties. Common materials used in the composition of anti-reflective coatings include metal oxides like titanium dioxide (TiO2) and silicon dioxide (SiO2). These materials are selected for their ability to decrease the amount of reflection occurring at the panel's surface, allowing a higher proportion of sunlight to enter the solar cells.

✳️ Tips For Protect Anti Reflective Coating:

✅️ Cleanliness: Regularly clean the solar panels to remove dust, dirt, and debris that can degrade the anti-reflective coating. Use a soft cloth or sponge and mild cleaning solution to gently wipe the surface.

✅️ Avoid abrasive materials: Never use abrasive or harsh cleaning agents, scrub brushes, or rough materials on the panels. These can scratch or damage the coating, reducing its effectiveness.

✅️ Use proper techniques: When cleaning, apply minimal pressure and avoid rubbing the surface forcefully. Instead, use a gentle wiping motion to prevent any potential damage.

✅️ Avoid extreme temperatures: Protect solar panels from extreme temperature fluctuations as these can expand or contract the coating, leading to cracking or peeling. Install panels in locations with optimal temperature conditions if possible.

✅️ Regular inspections: Routinely inspect the panels for any signs of damage to the anti-reflective coating, such as scratches or defects. Promptly address any issues to prevent further degradation.

✅️ Professional maintenance: If you are uncertain about cleaning or maintaining the anti-reflective coating, it is advisable to seek professional assistance. They have the expertise and knowledge to ensure proper care and safeguard the coating effectively.

[Human and environmental impacts of nanoparticles: a scoping review of ...](https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-023-15958-4#:~:text=Using%20several%20biological%20models%20and,and%20induction%20of%20inflammatory%20responses.)

[](https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-023-15958-4#:~:text=Using%20several%20biological%20models%20and,and%20induction%20of%20inflammatory%20responses.)

[biomedcentral.com](https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-023-15958-4#:~:text=Using%20several%20biological%20models%20and,and%20induction%20of%20inflammatory%20responses.)

[https://bmcpublichealth.biomedcentral.com › articles](https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-023-15958-4#:~:text=Using%20several%20biological%20models%20and,and%20induction%20of%20inflammatory%20responses.)

Which nanoparticles are toxic to human health?

Using several biological models and biomarkers, the included studies revealed the toxic effects of nanoparticles (mainly zinc oxide, silicon dioxide, titanium dioxide, silver, and carbon nanotubes) to include cell death, production of oxidative stress, DNA damage, apoptosis, and induction of inflammatory responses.Jun 3, 2023

PV Magazine **Ultra-thin silicon nanoparticle solar cell with 11% efficiency**Iranian scientists have demonstrated a multi-layer silicon nanoparticle (SNP) solar cell based on nanoparticles that are densely stacked inside a dielectric medium. They considered different SNP structures and configurations to tailor these particles as a p–n junction cell. Scientists in Iran have proposed the use of multi-layer [silicon dioxide (SiO2) nanoparticles](https://www.pv-magazine.com/2022/07/19/perovskite-silicon-tandem-solar-cell-with-23-5-efficiency/) (only later is it referred to as SiO2 **AUGUST 4, 2022** [**EMILIANO BELLINI**](https://www.pv-magazine.com/author/emilianobellini/)

* This following article is about NANO Structured TiO2 coating

# Antireflective Self-Cleaning TiO2 Coatings for Solar Energy Harvesting Applications

www.frontiersin.org[Adeel Afzal](https://www.frontiersin.org/people/u/1223443)1\* www.frontiersin.orgAmir Habib2 www.frontiersin.org[Iftikhar Ulhasan](https://www.frontiersin.org/people/u/1286312)2 www.frontiersin.orgMuhammad Shahid1 www.frontiersin.orgAbdul Rehman3

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Titanium(IV) oxide (TiO2, titania) is well-known for its excellent photocatalytic properties, wide bandgap, chemical resistance, and photostability. Nanostructured TiO2 is extensively utilized in various electronic and energy-related applications such as resistive switching memory devices, flat panel displays, photodiodes, solar water-splitting, photocatalysis, and solar cells. In particular, the energy harvesting efficiency of a solar cell is greatly diminished by the surface reflections and deposition of environmental contaminants over time. Nanostructured TiO2 coatings not only minimize reflection through the graded transition of the refractive index but simultaneously improve the device’s ability to self-clean and photocatalytically degrade the pollutants. Thus, novel approaches to achieve higher solar cell efficiency and stability with pristine TiO2 and TiO2-containing nanocomposite coatings are highlighted here. This article presents recent advances in the design and nanostructuring of TiO2-containing antireflective self-cleaning coatings for solar cells.hted herein. The results are compared and discussed to emphasize the key research and development shortfalls and a commercialization perspective is considered to guide future research.

..”Yet, a major limiting factor for the quantum efficiency of solar cells is the optical loss due to reflection. For instance, in the air atmosphere, a polished silicon surface reflects >30% of the incident solar radiations ([Thomas et al., 1989](https://www.frontiersin.org/articles/10.3389/fmats.2021.687059/full#B77)). Therefore, to reduce optical loss due to high reflectivity and improve the energy harvesting capability of solar cells, different solutions have been proposed such as the utilization of the antireflective coatings (ARCs), surface texturization, or a combination of both to increase the optical path length of the light within solar cells ([Singh and Verma, 2019](https://www.frontiersin.org/articles/10.3389/fmats.2021.687059/full#B72); [Abu-Shamleh et al., 2021](https://www.frontiersin.org/articles/10.3389/fmats.2021.687059/full#B3); [Sagar and Rao, 2021](https://www.frontiersin.org/articles/10.3389/fmats.2021.687059/full#B64)).

Furthermore, in terrestrial sunlight-to-electricity generation applications, solar modules and panels are exposed to dust, organic contaminants, industrial pollutants, and harsh environmental conditions, e.g., sand storms ([Said et al., 2015](https://www.frontiersin.org/articles/10.3389/fmats.2021.687059/full#B65); [Quan and Zhang, 2017](https://www.frontiersin.org/articles/10.3389/fmats.2021.687059/full#B60)), which also detriment their efficiency. The development of self-cleaning coatings is desired to address these issues ([Soklič et al., 2015](https://www.frontiersin.org/articles/10.3389/fmats.2021.687059/full#B74); [Huang et al., 2018](https://www.frontiersin.org/articles/10.3389/fmats.2021.687059/full#B28); [Zhi and Zhang, 2018](https://www.frontiersin.org/articles/10.3389/fmats.2021.687059/full#B89)). Ideally, a coating material for terrestrial solar cell applications should be robust, transparent, antireflective, and capable of self-cleaning itself.

. In this regard, an innovative way to produce highly porous ARC involves the sol-gel synthesis of TiO2 nanoparticles combined with block-copolymer self-assembly that yields excellent antireflective and photocatalytic properties ([Guldin et al., 2013](https://www.frontiersin.org/articles/10.3389/fmats.2021.687059/full#B23)).

of TiO2 ARCs.However, there is a need to design scalable and cost-effective approaches for their fabrication.”

Hold ON!! And HEALTH and SAFETY and WELFARE of all living species?

[CrossRef Full Text](https://doi.org/10.1002/pip.4670010109) | [Google Scholar](https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=The+First+Forty+Years:+A+Brief+History+of+the+Modern+Photovoltaic+Age&btnG=)



## [Journal of Materials Research and Technology](https://www.sciencedirect.com/journal/journal-of-materials-research-and-technology)

[Volume 28](https://www.sciencedirect.com/journal/journal-of-materials-research-and-technology/vol/28/suppl/C), January–February 2024, Pages 1475-1482

# Surface engineering of Sio2-Zro2 films for augmenting power conversion efficiency performance of silicon solar cells

Author links open overlay panel

Amira Ben Gouider Trabelsi a, Gobinath Velu Kaliyannan b, Raja Gunasekaran c, Rajasekar Rathanasamy d, Sathish Kumar Palaniappan e, Fatemah H. Alkallas a, W.B. Elsharkawy f, Ayman M. Mostafa g h

**PV Magazine-Titanium oxide nanoparticle-based perovskite PV cell with 24.05% efficiency**A new perovskite PV cell based on titanium dioxide nanoparticles exhibits low efficiency losses when scaled up from cell to module.**MAY 3, 2022** [**EMILIANO BELLINI**](https://www.pv-magazine.com/author/emilianobellini/)

QCells by Hanwha are represented for use by Borrego/New Leaf (although they say they can’t know make/modeluntil construction giving no time for review)-

“ Hanwha Q CELLS' solar cells are treated with a special nano coating that allows more sunlight to be reflected back through the cell to generate more electricity. Q. ANTUM Technology combines our patented rear-side passivation with an optimized power reflector and advanced silver paste printing tech”

That would be an Anti-reflective coating and or with hyhdrophobic coating using nanoparticles of WHAT? What nanoparticles are used in Q Cell anti-reflective coating?

Hanwha Q CELL description used by a developer to a client in Amherst, NH.

“PV MODULE REFLECTION – GLARE When light falls on a surface it is split; some of the light traverses the surface (transmission), some light enters the surface and is lost (absorption) and some is redirected away from the surface (reflection). In order for a PV module to produce as much power as possible, the cover glass is optimized for high transmission. This is why Hanwha Q CELLS PV modules have cutting-edge anti-reflective coatings (ARC) in order to maximize transmission and limiting the possibility for reflections. Each of these actions, transmission, absorption and reflection, can be measured as a proportion of the original light falling on the surface, eg. T + A + R = 100%. For our purposes it is only necessary to look at the proportion of this original light, as the intensity of the light falling on the surface of the PV module glass will change with numerous factors including different system configurations, locations and times of both the day and year. The proportion of light reflected from any surface is dependent upon the angle at which the light hits the glass, called the incident angle where 0° is direct light and 90° is parallel to the surface. The proportion of reflected light can be calculated for different incident angles using the Fresnel equations. For a sheet of glass it would be necessary to calculate the reflection twice, once for the frontside of the glass and once for the backside. However as the rear of PV module glass is connected to an EVA and light absorbing PV cell it is only necessary to consider the frontside effect. To calculate the reflection the refractive index of the involved media is needed. As an example air has an index of 1, for normal “window” glass the value is around 1.5, for water it is 1.33 and for PV module glass it is around 1.25. From these figures alone it is possible to, correctly, presume that the glass used in PV modules creates less reflected light than normal “window” glass or a body of water. Figure 2 shows the curves of these different cases, along with measurements by TÜV Rheinland of Hanwha Q CELLS modules. It can be seen that the proportion of light reflected starts close to zero but rises as the incident angle gets closer to 90°. CONCLUSION From both the theoretical and measured data it is clear that ARC glass used in all Hanwha Q CELLS currently produced PV modules reflects less light than both naturally occurring features, such as bodies of water, and common manmade structures. Moreover for incident angles below 55° less than 4% of the initial light is reflected away from the PV module.”Hanwha Q CELLS' solar cells are treated with a special nano coating that allows more sunlight to be reflected back through the cell to generate more electricity. Q. ANTUM Technology combines our patented rear-side passivation with an optimized power reflector and advanced silver paste printing technology.”

“Hanwha Q CELLS' solar cells are treated with a special nano coating . no mention of ARC constituent materials after that long winded explanation of refracted light. The stuff that could make its way into wetlands, your soil and water is a mystery.

Hanwha Solar is a product brand of Hanwha Q CELLS Co., Ltd., which emerged as a new global solar power leader from combining two of the world´s most recognized photovoltaic manufacturers, former Hanwha SolarOne and Hanwha Q CELLS. Hanwha Solar is a regional product brand, e. g. to serve market needs in China, Japan, Korea, Turkey and other non-EU markets. Hanwha Solar is represented by Hanwha SolarOne module portfolio with its module types HSL 60 S and HSL 72 S.

Google search shows many results of tiO2 and ZrO2 used in ‘Anti Reflective Coatings for solar separately and in combination. Nanoparticles are predominate.

[National Institutes of Health (NIH) (.gov)](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2844666/)

[https://www.ncbi.nlm.nih.gov › articles › PMC2844666](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2844666/)by PC Ray · 2009 · Cited by 852 — Though several research groups have found **toxic effects** of nanomaterials, the causes for the **toxicity** are mostly unknown. ... Communicating research on ...People also askWhat are the toxic effects of nanotechnology?What are the possible health risks of nanotechnology?What are 3 negative impacts of nanotechnology?What is a concern that people have about nanotechnology?[Nanoparticles‐induced potential toxicity on human healthNational Institutes of Health (NIH) (.gov)https://www.ncbi.nlm.nih.gov › articles › PMC10349198](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10349198/)by L Xuan · 2023 · Cited by 21 — The mechanisms underlying the **toxic effects** of NPs are complex and depend on various factors such as size, shape, surface chemistry, and ...[Human and environmental impacts of nanoparticlesBMC Public Healthhttps://bmcpublichealth.biomedcentral.com › articles](https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-023-15958-4)by EA Kumah · 2023 · Cited by 35 — This work has revealed the **toxic effects** of nanoparticles to include production of oxidative stress, DNA damage, apoptosis, cell death, and ...[Phys.orghttps://phys.org › Chemistry › Materials Science](https://phys.org/news/2023-02-solar-cells-toxic.html)Feb 28, 2023 — Scientists from Skoltech and other research centers have systematically studied the **toxicity** of materials used in perovskite **solar** cells.

[Should you be worried about nanotoxicity?HORIBAhttps://www.horiba.com › resources › science-in-action](https://www.horiba.com/int/scientific/resources/science-in-action/should-you-be-worried-about-nanotoxicity/) Sayes believes people should be **worried** about **toxicity** or **toxicities** in general,because exposures to pharmaceuticals, chemicals, environmental agents, or ...[Toxicity of nanoparticles\_ challenges and opportunities](https://appmicro.springeropen.com/articles/10.1007/s42649-019-0004-6)

[SpringerOpenhttps://appmicro.springeropen.com › articles](https://appmicro.springeropen.com/articles/10.1007/s42649-019-0004-6)by A Ramanathan · 2019 · Cited by 28 — **Nanotoxicity** is an emerging discipline and the importance of further research on the mechanisms and factors that increase **toxicity** and **risk** ...[(PDF) Third‐Generation Solar Cells: Toxicity and Risk of ...ResearchGatehttps://www.researchgate.net › publication › 34315839...](https://www.researchgate.net/publication/343158391_Third-Generation_Solar_Cells_Toxicity_and_Risk_of_Exposure)Jul 22, 2020 — ical research. In vitro studies and studies in zebrafish embryos. have identified twopossible **toxic** mechanisms of QD;. **toxicity** induced by ...[Challenges for Assessing Toxicity of NanomaterialIntechOpenhttps://www.intechopen.com › chapters](https://www.intechopen.com/chapters/70500)by A Gupta · 2019 · Cited by 24 — Nevertheless, it is hard to assess and validate the **nanotoxicity** in a biological system. This chapter aims to study the challenges in determining the **toxicity** ...[Nanotech: The Unknown RiskYale E36 https://e360.yale.edu › features › nanotech\_the\_unkno...](https://e360.yale.edu/features/nanotech_the_unknown_risks)Jun 23, 2008 — So a substance that's safe at a normal size can become **toxic** at the **nanoscale**. ... **solar** cells to super-efficient water filtration. ... Her work on ...[Toxicity of manufactured nanomaterialsScienceDirect.comhttps://www.sciencedirect.com › sciencearticle › pii](https://www.sciencedirect.com/science/article/pii/S167420012100225X)by Y Liu · 2022 · Cited by 63 — The higher **toxicity** of **nano**-ZnO is tightly associated with its dissolution into **toxic** ... **Sun**, H. ... **Effects** of changing exposure forms on bioaccumulation and ...

[OUCIhttps://ouci.dntb.gov.ua › works](https://ouci.dntb.gov.ua/en/works/9GEY10e4/)**ZrO2** incorporated TiO2 based **solar reflective** nanocomposite **coatings** on glass to be used as energy saving building components.[Solar synthesis of nanostructured zirconiaIOPsciencehttps://iopscience.iop.org › article › abcbb8](https://iopscience.iop.org/article/10.1088/2053-1591/abcbb8)by LG Ceballos-Mendivil · 2020 · Cited by 2 — ... **nanoparticles** can be used as fillers in transparent **coatings**, such as **anti**-corrosive, **anti**-**reflective** and scratch-proof **coatings** [21]. ZrO2 is a metal oxide ...[Optical and mechanical properties of Zr-oxide doped TiO2/ ...SSRN eLibraryhttps://papers.ssrn.com › sol3 › Delivery.cf](https://papers.ssrn.com/sol3/Delivery.cfm/f091fc86-6bdb-4ab1-935d-0881e44c864c-MECA.pdf?abstractid=4072651&mirid=1) PDF... antireflective optical coatings, **Nano** abrasive-resistant, long-lasting **anti**-**reflective coating** for **PV** module glass, 2014 IEEE ... **ZrO2**/SiO2 double-layer ...

[Trends in High-Performance Optical Coatings with ...Cerion Nanomaterialshttps://cerionnano.com › uploads › 2018/10 › Tre...](https://cerionnano.com/wp-content/uploads/2018/10/Trend-report-full_Optical-coatings.pdf)by T Hendrick — Functional **nano**-textured titania-**coatings** with self-cleaning and **antireflective** properties for **photovoltaic** surfaces. **Solar** Energy. 125, 227–242 (2016). 10 …[Non-Vacuum Processed Polymer Composite Antireflection ...Semantic Scholarhttps://pdfs.semanticscholar.org › ...](https://pdfs.semanticscholar.org/e141/090d2268e4a06084a7445f8acdcd05193c24.pdf)PDFby A Uzum · Cited by 12 — ... (**ZrO2**-P/SD-TiO2-P) composite films were introduced as alternative **anti**-**reflection coating** films for the fabrication of silicon **solar** cells.[Refractory materials monoclinic ZrO2 nanoparticle nano .hwnanoparticles.comhttps://www.hwnanoparticles.com › refractory-materials...](https://www.hwnanoparticles.com/refractory-materials-monoclinic-zro2-nanoparticle-nano-zirconium-oxide-powder-product/)7. **Solar** cell **anti**-**reflection** film **coating**, **nano**-**zirconia** has good dispersibility, and is **coated** on the **solar** cell glass surface to form **anti**-**reflection** film ..

# **Toxicity Induced by Zirconia Oxide Nanoparticles on Various Organs After Intravenous Administration in Rats**

[Ting Sun](https://pubmed.ncbi.nlm.nih.gov/?term=Sun+T&cauthor_id=30841966), [Gengbo Liu](https://pubmed.ncbi.nlm.nih.gov/?term=Liu+G&cauthor_id=30841966), [Lingling Ou](https://pubmed.ncbi.nlm.nih.gov/?term=Ou+L&cauthor_id=30841966), [Xiaoli Feng](https://pubmed.ncbi.nlm.nih.gov/?term=Feng+X&cauthor_id=30841966), [Aijie Chen](https://pubmed.ncbi.nlm.nih.gov/?term=Chen+A&cauthor_id=30841966), [Renfa Lai](https://pubmed.ncbi.nlm.nih.gov/?term=Lai+R&cauthor_id=30841966), [Longquan Shao](https://pubmed.ncbi.nlm.nih.gov/?term=Shao+L&cauthor_id=30841966)

* PMID: 30841966
* DOI: [10.1166/jbn.2019.2717](https://doi.org/10.1166/jbn.2019.2717)

## **Abstract (NPs are nanoparticles)**

ZrO₂-NPs are widely applied in industry, biomedicine and dentistry, e.g., foundry sands, refractories, ceramics dental prostheses, dental implant coatings and bone defect restorative materials. To date, little information is available on the potential adverse effects and toxic mechanism in human organs associated with exposure to ZrO₂-NPs. The biodistribution of ZrO₂-NPs and the consequent oxidative stress in the spleen, kidney, heart, brain, and lung at six time points after a single injection of ZrO₂-NPs were examined. Histopathological and immunohistochemical changes were also examined. RNA-Seq analysis was conducted in organs with high ZrO₂-NPs accumulations or obvious histopathological changes (brain and spleen).Exposure to the ZrO2-NPs led to persistent oxidative stress and cell proliferation promotion/inhibition in various organs. RNA-Seq results of the spleen and brain point to significant gene expression changes. Metabolism was identified as leading pathways in the spleen. This study proves ZrO2-NPs likely have negative impacts on various organs, and exhibit potential disease risks.

[PubMed Disclaimer](https://pubmed.ncbi.nlm.nih.gov/disclaimer/)Physiological Effects of Nanoparticles on Fish

**Abstract**

“The use of nanoscale materials is growing exponentially, but there are also concerns about the environmental hazard to aquatic biota. Metal-containing engineered nanoparticles (NPs) are an important group of these new materials, and are often made of one metal (e.g., Cu-NPs and Ag-NPs), metal oxides (e.g., ZnO and TiO(2) NPs), or composite of several metals.”

<https://pubmed.ncbi.nlm.nih.gov/21474182/> Although data sets are still limited, emerging studies on the acute toxicity of nanometals have so far shown that these materials can be lethal to fish in the mg-μgl(-1) range, depending on the type of material. Evidence suggests that some nanometals can be more acutely toxic to some fish than dissolved forms. For example, juvenile zebrafish have a 48-h LC(50) of about 0.71 and 1.78mgl(-1) for nano- and dissolved forms of Cu respectively. The acute toxicity of metal NPs is not always explained, or only partly explained, by the presence of free metal ions; suggesting that other novel mechanisms may be involved in bioavailability. Evidence suggests that nanometals can cause a range of sublethal effects in fish including respiratory toxicity, disturbances to trace elements in tissues, inhibition of Na(+)K(+)-ATPase, and oxidative stress. Organ pathologies from nanometals can be found in a range of organs including the gill, liver, intestine, and brain. These sublethal effects suggest some common features in the sublethal responses to nanometals compared to metal salts. Effects on early life stages of fish are also emerging, with reports of nanometals crossing the chorion…

Nano- and microplastics: a comprehensive review on their exposure routes, translocation, and fate in humans

For decades with complicity from the EPA, Dupont said PFAS was not causing horrible poisoning of people, animals and the land and water.

Would we had listened to the contrarians and thank Goodness for the one lawyer who, with persistent urging from his grandma to help her friend, represented one farmer, The farmer died before being vindicated and the lawyer sacrificed for years to reach the public awareness and science that we now know was suppressed and lied about by a criminally negligent corporations. Dupont Tedlar is the polymerpfas, polyvinylfluoride, on the Jinko panels said in the site plan to be on Fearing Hill with potential toxic adverse or toxic consequences to the wetlands and all living species within the watershed that now provide our ecosystem with mineralized, florist filtered,root slowed, cooling, clean Life Sustaining water.

Not only can some PFAS occur as microplastics such as polyvinyl fluoride (PVF) and polytetrafluorethylene (PTFE), it is also used as a coating on synthetic textiles and plastic components that then break down to fiber- or particle-based macro-, meso-, or microplastics. Moreover, non-PFAS microplastics can involve PFAS at certain stages in their production process, for example polyvinyl chloride (PVC). <https://www.wateronline.com/doc/the-microplastics-and-pfas-connection-0001>