

A Study on ZnO Nanoparticles

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Abstract

An infusible white solid ZnO used especially as a pigment, in compounding rubber, and in pharmaceutical and cosmetic preparations (such as ointments and sunblocks). The most common use of ZnO nanoparticles is in sunscreen. They are used because they effectively absorb ultraviolet light, but possess a large enough bandgap to be completely transparent to visible light. ZnO nanoparticles were prepared by refluxing precursor zinc acetate dihydrate (0.1 M) in diethylene glycol and triethylene glycol at 180 °C and 220 °C respectively. Reaction time varied for 2 and 3 h with and without sodium acetate (0.01 M). ZnO with a wurtzite structure is naturally an n-type semiconductor because of a deviation from stoichiometry due to the presence of intrinsic defects such as O vacancies O(v) and Zn interstitials Zn(i). Zinc oxide is an inorganic compound with the formula ZnO. It is a white powder that is insoluble in water. ZnO is present in the Earth's crust as the mineral zincite. That being said, most ZnO used commercially is synthetic. In summary, it is concluded on the basis of available evidence that the use of ZnO nanoparticles with the characteristics as indicated below, at a concentration up to 25% as a UV-filter in sunscreens, can be considered not to pose a risk of adverse effects in humans after dermal application.

Keywords: ZnO nanoparticles, intrinsic defects, inorganic compound, fungus, toxic, harmful

I. Introduction

Zinc oxide (ZnO) is an interesting material with respect to conductivity. It crystallizes in the wurtzite structure, and its bonding is a mix of ionic and covalent. What is miconazole and zinc oxide topical? Miconazole and zinc oxide topical (for the skin) is a combination antifungal medicine that fights infections caused by fungus. Zinc oxide (ZnO) is a common inorganic compound with a large number of uses. It is insoluble in water but soluble in dilute acids and bases. Pure ZnO is has basic nature (nanopowder). However if dissolved in ethanol the solution is acid. ZnO is amphoteric, so it can have both acidic or basic behaviour, depending on the media it is placed in ZnO is amphoteric, so it can have both acidic or basic behavior, depending on the conditions. Zinc oxide nanoparticles are generally synthesized by mechanochemical processes and can be prepared by sol-gel processes and spray pyrolysis (Espitia et al., 2012; Silvestre et al., 2013). Zinc oxide is used as a bulking agent and a colorant. In over-the-counter drug products, it is used as a skin protectant and a sunscreen. Zinc oxide works as a sunscreen by reflecting and scattering UV radiation. Sunscreens reduce or prevent sunburn and premature aging of the skin. Wurtzite ZnO has polar surfaces, such as (0001) and (000-1), and non-polar surfaces such as {01-10} and {2-1-10}. Zinc is obtained

from ZnO by Carbon reduction. ZnO has a band gap of 3.37 eV, which corresponds to emission in the UV region. However, ZnO has some significant advantages in its large free exciton binding energy (60 meV compared to 21-25 meV for GaN) that allows for efficient excitonic emission at room temperature.

II. Methodology

II.A Identification of ZnO

Pure ZnO is a white powder, but in nature it occurs as the rare mineral zincite, which usually contains manganese and other impurities that confer a yellow to red color. Crystalline zinc oxide is thermochromic, changing from white to yellow when heated in air and reverting to white on cooling.

II.B Is ZnO a solid liquid or gas?

Crude zinc oxide is a yellow-gray granular solid with no odor. It is insoluble in water.

II.C Is ZnO a metal oxide?

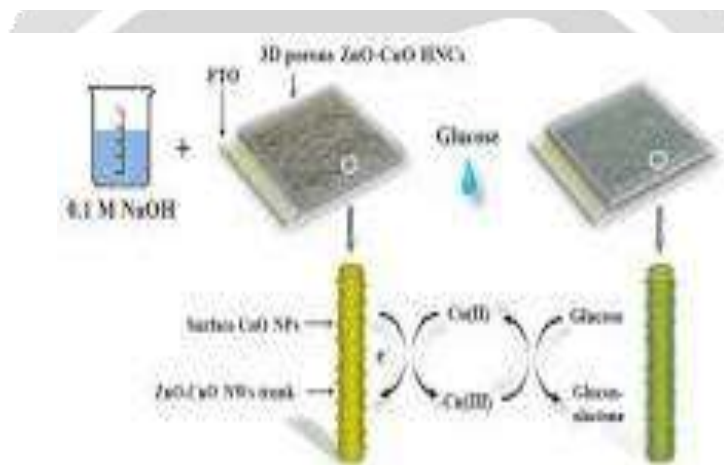


Fig.1 ZnO n-type semiconductor metal

Zinc oxide (ZnO), an n-type semiconductor metal oxide with a wide direct band gap of 3.37 eV, a large exciton binding energy of 60 meV, and enhanced electron mobility, that has gathered attention for a broad range of applications in biomedical and clinical sciences.

II.D What type of bond is Zn?

Zinc exhibits only the +2 oxidation state. It can give up two electrons to form an electrovalent compound; e.g., zinc carbonate $ZnCO_3$. It may also share those electrons, as in zinc chloride, $ZnCl_2$, a compound in which the bonds are partly ionic and partly covalent.

II.E How bad is zinc oxide for you?

Zinc oxide is not very poisonous if it is eaten. Long-term recovery is very likely. However, people who have had long-term exposure to metal fumes may develop serious lung disease.

II.F Is zinc oxide good for skin?



Fig.2 Zinc Oxide metal

One of the safest ingredients, zinc oxide can give your skin the protection it needs from harmful UV rays. It helps protect cells from being damaged, halts the ageing process, and prevents skin dryness by filtering out the harmful UV rays.

II.G Why is nano zinc bad?

The concern with these super-small nanoparticles is that they can find their way into your body by penetrating your skin and getting into your bloodstream. And while a nanoparticle will enter your bloodstream, a non-nano particle won't. For that reason, non-nano is considered safer.

III. H Is ZO harmful?

Generally, exposure to ZnO has been linked to adverse health and environmental effects (89–92) reported oxidative DNA damage in workers exposed to metal oxide Nms. ROS may cause ZnO NPs-induced cytotoxicity and genotoxicity. ZnO NPs are more toxic than other metallic oxide NPs because of their ion-shedding ability

II.I Are zinc oxide nanoparticles safe?

In summary, it is concluded on the basis of available evidence that the use of ZnO nanoparticles with the characteristics as indicated below, at a concentration up to 25% as a UV-filter in sunscreens, can be considered not to pose a risk of adverse effects in humans after dermal application.

II.J What is wrong with nano zinc oxide?

The concern with these super-small nanoparticles is that they can find their way into your body by penetrating your skin and getting into your bloodstream. And while a nanoparticle will enter your bloodstream, a non-nano particle won't. For that reason, non-nano is considered safer.

II.K Is Zinc oxide cancerous?

The TGA's conclusion was that nanoparticles used as ingredients in sunscreens are unlikely to cause harm when sunscreens are used as directed. In addition, titanium dioxide and zinc oxide nanoparticles are not considered to be carcinogenic by the US Report on Carcinogens¹ or the IARC.

II.L Is it safe to use zinc oxide everyday?

Topical zinc oxide products may be applied to affected areas several times daily as necessary. Do not apply to large areas or on blistered or broken skin. Avoid contact with eyes and mucous membranes.

II.M Is zinc oxide an antifungal?

What is miconazole and zinc oxide topical? Miconazole and zinc oxide topical (for the skin) is a combination antifungal medicine that fights infections caused by fungus.

II.N What are the disadvantages of using nanoparticles in sunscreen?

Bulk zinc oxide is white, but nanoparticulate zinc oxide is invisible on the skin. Many people prefer nanoparticulate sunscreen for this reason. One disadvantage of nanoparticulate sunscreens is that they tend to clump together, making them difficult to apply. Suggest another disadvantage of these sunscreens.

II.O What is the advantage of using zinc oxide nanoparticles in sunscreen?

Despite clumping together when mixed into sunscreen, nanoparticles of titanium dioxide and zinc oxide not only retain their highly effective UV light-absorbing capacity, but also absorb and scatter visible light, rendering them transparent on the skin.

II.P Does Invisible Zinc use nanoparticles?

Under the heading Micronised (Not Nano) Sunscreens, the website explains that Invisible Zinc uses zinc oxide particles which are up to 50 times larger than the size of typical nanoparticles in some other sunscreens. Nanoparticles are smaller than 100 billionths of a metre.

II.Q Is zinc oxide safe for babies?

A lick or swallow of a zinc oxide or lanolin cream is not dangerous to a child; larger amounts can cause nausea, vomiting, and diarrhea, though this is unusual. Petroleum jelly is used as a moisture barrier by some parents. A child who swallows a small amount will probably be OK.

II.R Why are nano sunscreens bad?

However, it may be dangerous to inhale or ingest nanoparticles. ... Once swallowed, nanoparticles – from lip sunscreens, for example – can damage the gastrointestinal tract, although there are no studies to suggest consumers swallow enough zinc oxide or titanium dioxide for this to pose a concern.

II.S Is non-nano zinc oxide safe for babies?

This sunscreen is not only non-nano, but it's also formulated from 93% naturally derived ingredients, which include vitamin E, coconut oil, and macadamia oil. This product is also safe to use on your little one from birth. And the natural ingredients make it perfect for people with sensitive skin!

II.T Is zinc oxide good for your face?

Zinc oxide is used for its many benefits to the skin. It is thought that zinc oxide may help to minimise irritation, support wound healing, seal in moisture and protect the skin against the effects of UV rays. Studies suggest that it works well for scenic skin types and as an SPF, when used correctly.

II.U What are the worst sunscreens?

Most Toxic Sunscreens to Avoid:

(i)Walgreens Dry Touch Sunscreen Lotion, SPF 100.(ii)Panama Jack Sunscreen Continuous Spray, SPF 100.(iii)Neutrogena Ultra Sheer Dry-Touch Sunscreen Lotion, SPF 85+(iv)Neutrogena Ultra Sheer Dry-Touch Sunscreen Lotion, SPF 100+ and (v)Neutrogena Ultra Sheer Body Mist Sunscreen Spray, SPF 100+

IV. Results and discussion

There is a misconception that more Zinc Oxide in a product will deliver a higher level of UV protection and it just isn't true. It's not that simple. Percentage of Zinc Oxide in a product does not equate to higher or lower SPF or more or less UVA protection. Zinc oxide protects against both the UVA and UVB rays of the sun.

By making the ingredients “non-nano” it means that the particles aren't small enough to penetrate the skin. This is considered safer for your body. True physical sunscreens contain either zinc oxide or titanium dioxide as their only active ingredient. Again, zinc oxide sunscreen does not expire and does not lose its ability to protect skin from UV rays.

While zinc oxide won't whiten skin, it should be part of your treatment plan for dark spots or melasma, according to the American Academy of Dermatology. When used daily, broad-spectrum sunscreen with zinc oxide that's SPF 30 or higher can help prevent further darkening of the skin. What: Zinc oxide is a natural mineral which provides the safest and most effective protection against UV rays.

Unlike chemical sunscreens, zinc forms a physical barrier on the skin, reflecting the sun's rays rather than absorbing them. A very serious allergic reaction to this drug is rare. However, seek immediate medical attention if you notice any symptoms of a serious allergic reaction, including: rash, itching/swelling (especially of the face/tongue/throat), severe dizziness, trouble breathing.

Research indicates that zinc is a useful treatment option for itch because it inhibits mast cell degranulation, reducing the secretion of histamine which can contribute to itch. Zinc oxide can improve mild skin irritations like rashes or cuts on your lips. Zinc oxide is the only active sunscreen ingredient that covers the entire UVA/UVB spectrum by itself, giving your lips true broad-spectrum protection.

Non-nano zinc oxide is safe for reefs and marine life. Zinc status has been shown to influence various cell-mediated immunologic mechanisms. These cell-mediated mechanisms are important in preventing mucocutaneous infections caused by *Candida albicans*.

In dermatophytosis, miconazole showed accelerated response (75% cleared in 6 weeks) than clotrimazole (56%). In candidiasis, both were found to be effective (80-85%) cure though clotrimazole showed slightly earlier response (40% cure in 6 weeks) against miconazole (30% cure).

Nanoparticles have a very high surface area to volume ratio and make excellent catalysts. Self-cleaning window panes have nanoparticulate coatings.

Zinc oxide is unique among sunscreen ingredients in that it is truly a broad-spectrum blocker, protecting from UVA, UVB, and even UVC.

Avobenzone is a member of dihydrochalcones. Avobenzone is dibenzoyl methane derivative. It is oil soluble ingredient. Avobenzone has the ability to absorb ultraviolet light over wider range of wavelengths.

Zinc oxide is the active ingredient in many diaper rash products. They are usually applied to the rash throughout the day to soothe and protect your baby's skin. It doesn't take much – a thin covering will do. The product can be applied over medicated creams, such as an antifungal or a steroid, when necessary.

It is the active ingredient in Johnson's Baby Oil. Zinc oxide (25%-40%) pastes and ointments are safe and effective for diaper rash, but in higher concentration they are difficult to remove from the baby's skin due to their thick and adherent nature.

For every 1% of each active ingredient, you get a certain amount of SPF units. As you can see in the chart above, 1% zinc oxide gives you 1.6 SPF units, while 1% titanium dioxide gives you 2.6 SPF units. So let's say you have a formula with 20% zinc oxide.

V. Conclusion

One disadvantage of ZnO and TiO₂ particles is that, when their size is in the range of a micrometre, they are visible on the skin as an opaque white layer and this resulted in reluctance of consumers to use sunscreens products containing them. At the same time, many published research studies showed the toxic effects of zinc oxide nanoparticles on some specific organs and cell lines. These toxic effects were attributed to the high solubility of the particles, resulting in cytotoxicity, oxidative stress, and mitochondrial dysfunction.

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