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ZnO NANOPARTICLE BY SOL-GEL AND ITS UV APPLICATION IN COSMETICS FORMULATION

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Abstract- ZnO nano by sol-gel zinc acetate dihydrate. The obtained ZnO nano-particle exhibit well-defined morphologies, single-crystalline orientation, and clean surface without amorphous contamination. The product was characterized scanning electron microscopy. ZnO nano particle (NP) use in cosmetics
Keywords- Zinc Oxide, sol-gel, SEM, UV, cosmetic

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Introduction

The harmful effects of both short-term and long-term sun exposure have been well described and range from accelerated skin aging to skin cancer. One of the most common approaches to prevent this damage or harm is with the application of sunscreens, which contain a variety of chemicals and minerals that act to block or reflect ultraviolet (UV) radiation, the component of sunlight that is responsible for many of its harmful effects. For years, titanium dioxide (TiO_2) and zinc oxide (ZnO) have been used in sunscreens since they serve as a physical barrier UV radiation and thus decrease the amount of radiation to which the skin is exposed. However, these ingredients in their native state are not water soluble, but are opaque and coat the skin when applied with an oily and cosmetically displeasing white residue, resulting in limited consumer use. In recent years, there has been a revival of TiO2 and ZnO use in sunscreens as the science of nanotechnology has allowed for improved versions of these products.

Nanotechnology involves the design, production, and application of materials that are extremely small, (1 nanometer = one billionth of a meter) 1. When this technology is applied to sunscreens, specifically nano-sized TiO_2 and ZnO, these products do not have the thick feel or unsightly chalky film as compared to their predecessors. Even more importantly, sunscreens with these nanomaterials offer superior UV protection when compared to conventional formulations. However, many organizations and regulatory bodies have raised concerns regarding the safety of nanoparticle sunscreens.

In this report we presented the low cost preparation of ZnO in room temperature having flower like morphology and large surface area which good for cosmetics.

Material

All chemicals iluding Zinc acetate dehydrated, ammonia and starch were analytical grade and purchased from commercial market without further purification.

Experiment

The sol-gel was used for the preparation of ZnO nano particle. The ZnO crystalline powder was prepared in the following process. The aqueous solution (0.1 mol/L) of zinc acetate dihydrate was prepared in starch solution. The pure ammonia was slowly added into zinc acetate solution, then white suspension obtained. Then it refluxed for half an hour. The suspension was then separated with a centrifuge and washed three times with distilled water, and washed with absolute alcohol at last.

Result and discussion

SEM

Syntheses of zinc oxide nanomaterials by direct precipitation and surface modification with the UV absorption property of a ZnO nanoparticle was also evaluated. The following conclusions can be drawn from our experiments and analyses: The ZnO nanoparticles obtained here were nearly spherical flower particles with a size about 50-100 nm. ZnO nano particles in starch exhibited excellent UV shielding and transparency properties.

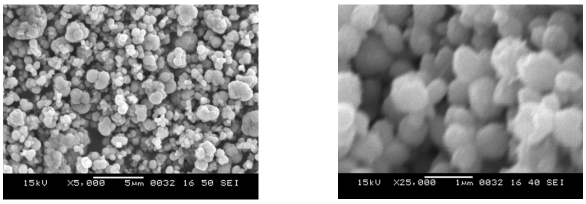

Fig. 1- indicated the SEM image which has flower like morphology in range of 50-100 nm

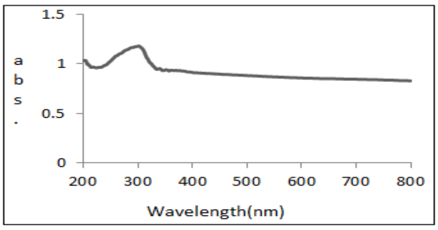

Fig. 3- Absorption of bulk ZnO at room temperature.

Sunlight and its Effect on Skin

UV radiation is a part of the solar spectrum occupying a range of 100-400 nm. It is conventionally divided into three sub-ranges:45 UVC (100-280 nm), UVB (280-315 nm) and UVA (315-400 nm). The former is completely absorbed by the ozone layer of the atmosphere located at a height of 18-40 km above the Earth's surface. The latter two are also attenuated: UVB-about 25 times, UVA -about 2 times, so that both fractions finally represent 5% of the solar intensity at sea level. They reach the atmosphere-ground interface and affect humans. Both

types of rays could be harmful, if a certain dose of radiation on the skin is exceeded. The solar spectrum above the atmosphere is represented in Fig 2. The influence of UV radiation can be either acute or chronic. The former includes sunburn and sun tanning as well as production of vitamin D. The chronic effects are skin cancer and photoaging. The UVB fraction is responsible for sunburn and increases the risk of certain types of skin cancer (basal-cell carcinoma and squamous cell carcinoma) due to direct DNA damage. The UVA fraction

causes sun tanning, photoaging, and malignant melanoma by indirect DNA damage (by means of free radical formation). Although malignant melanoma is rare, it is responsible for 75% of all skin-cancer-related deaths. According to investigations, 92% of all melanoma cases are caused

by indirect DNA damage and only 8% of the melanoma is caused by direct DNA damage.46 Moderate sun tanning can prevent sunburn due to increased production of melanin, natural protector against overexposure to UV radiation.

Photoprotective Properties ZnO

ZnO nanomaterials are efficient absorbers of UV radiation: they absorb both UVB and UVA radiation and re-emit it as less damaging UVA, as visible fluorescence or heat. At the present time, formulations with ZnO as the active ingredients are the best sunscreen agents due to their superior photoprotective properties and reduced risk of irritation compared to other sunscreen ingredients. Avobenzone offers protection against UVA rays, but it can also be a skin irritant. An ideal sunscreen formulation must efficiently block UVA/UVB radiation, be non-toxic and aesthetically appealing. It is critically important to block UVA radiation, as its skin penetration depth on average exceeds the thickness of the stratum corneum. In other words, UVA radiation can reach the viable epidermis layer and cause photodamage to its cells. UVB is largely absorbed in the stratum corneum. ZnO abilities to attenuate UVA radiation in cosmetic formulations were compared. UVA attenuation was measured by diffuse reflectance spectroscopy on normal human skin *in vivo*. ZnO-NPs demonstrated superior protection compared to TiO2-NPs in the UVA spectral region between 340 and 380 nm. It is obvious in hindsight by examining Figure 3, which shows a rapid onset of absorption of ZnO at 380 nm, where the TiO_2 absorption just kicks at 380 nm and reaches its full efficiency at 310 nm. It is noteworthy that the photoprotective properties of sunscreen NPs need to be evaluated in the context of their distribution in skin, and skin intrinsic UV absorption and scattering properties. When the NP diameter is 60 nm, whereas 120-nm particles stop 25% of UVA radiation by reflecting it back from the skin surface. It is a combination of absorption and scattering properties that needs to be considered when designing the NP-based sunscreen formulation

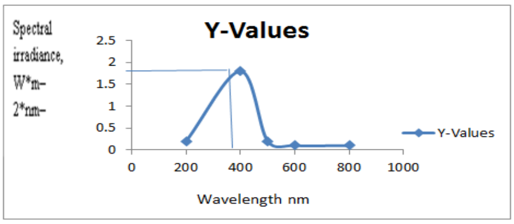

Fig. 2- Solar spectrum above the atmosphere

Conclusion

Syntheses of zinc oxide nanomaterials by direct precipitation and surface modification with starch have been reported. Furthermore, the UV absorption property of a ZnO nanoparticle was also evaluated. The following conclusions can be drawn from our experiments and analyses: The ZnO nanoparticles obtained here were nearly spherical-flower particles with a size about 50-100 nm. Sol-gel ZnO nanoparticles exhibited excellent UV shielding and transparency properties.

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