AN EVALUATION OF ACUTE TOXICITY AND AQUATIC TOXICITY OF TITANIUM DIOXIDE NANOPARTICLES

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DOST-ITDI

DOST

Department of Science and Technology

is the executive department of the Philippine Government responsible for the coordination and formulation of policies and projects in the fields of Science and Technology in support of the national development.

“Environmental, Health and Safety Research in the Risk Assessment of Nanomaterials”

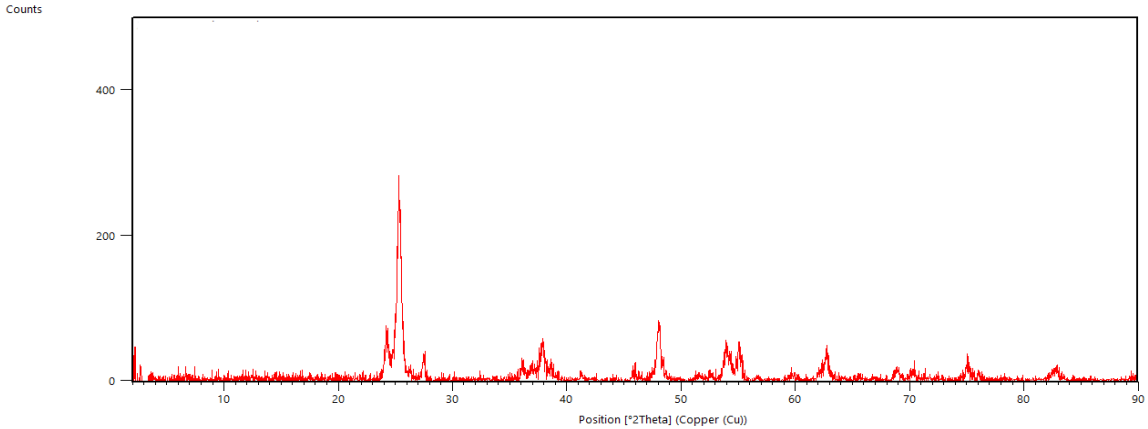
To establish capability on the assessment of nanomaterials in terms of safety and efficiency

To gather primary safety data for nanomaterials in the Philippines

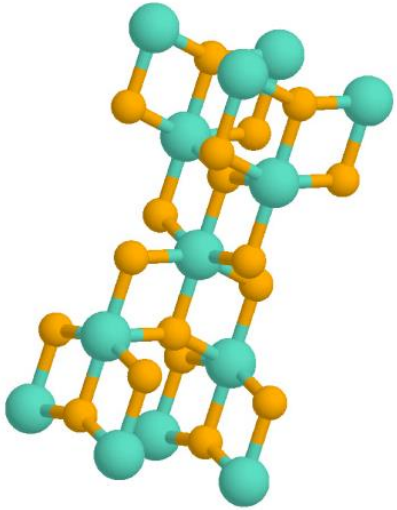
To review and assess the testing manuals on nanotechnology based on existing ISO standards.

Nano TiO_2 in the Philippines

Nano TiO_2 Characterization



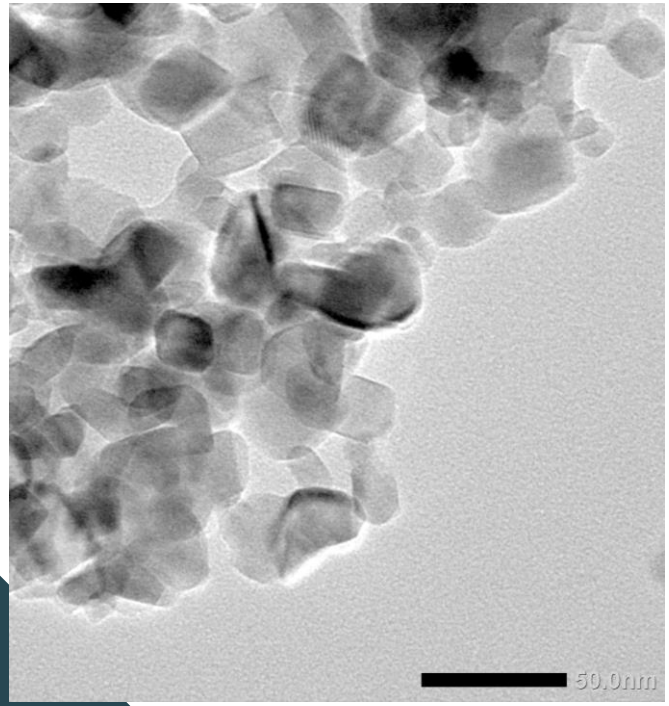
Zeta Potential	-39.2 mV
BET surface area	52.416 m^2/g
WDXRF elemental analysis	Ti 99.5%

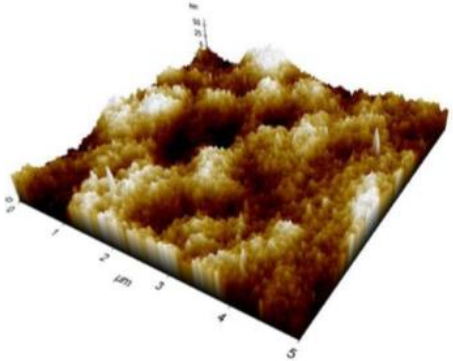


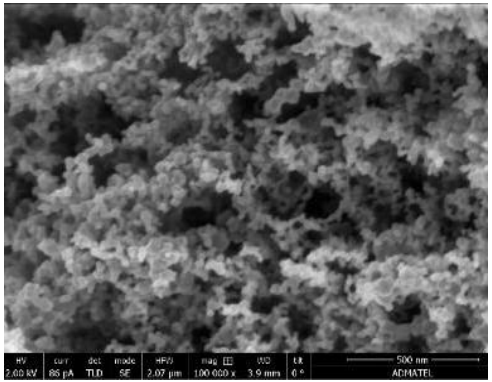
Anatase

Current Intelligence Bulletin 63 – Occupational Exposure to Titanium Dioxide.pdf

Nano TiO_2 Characterization







Method	Particle size (nm)
DLS	87.1
XRD	25.1
AFM	31.83
TEM	30

ACUTE TOXICITY STUDIES

01 DERMAL IRRITATION

02 EYE IRRITATION

03 ACUTE ORAL TOXICITY

https://images.app.goo.gl/mqUyMVfoee42fcp99

01

Dermal Irritation Test (Modified Draize Method)

RESULT

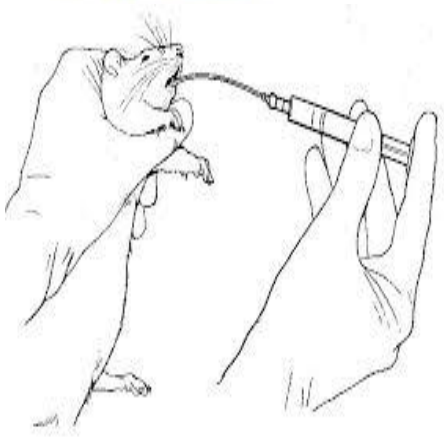
No gross lesions observed on the skin of the rabbits exposed to 0.5 mg dose.

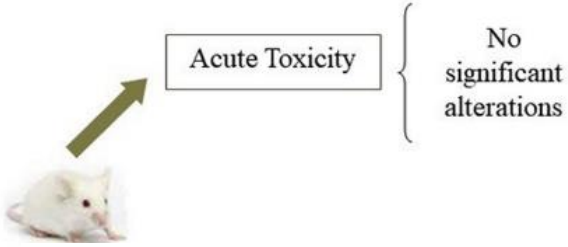
02 Eye Irritation Test (OECD 405)

RESULT

No mortality and no gross lesions observed on the rabbit’s eyes within 14 days post application of 0.5 mg nano TiO_2.

03 Acute Oral Toxicity (OECD 420)

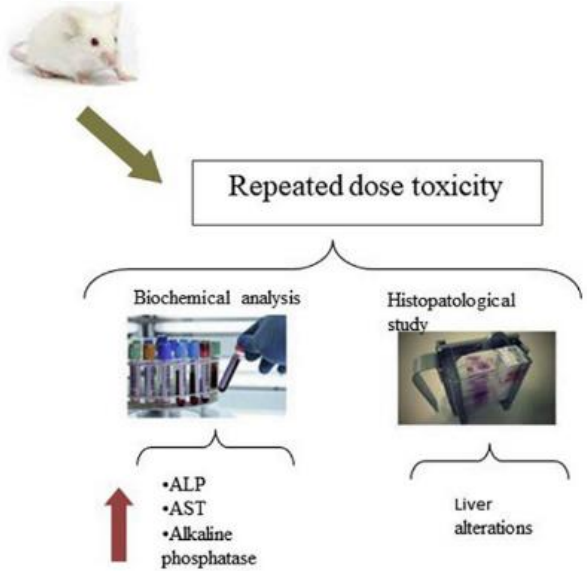




RESULT

Lethal Dose (LD50) is greater than 5,000 mg/kg body weight which is under Category 5 Globally Harmonized System (GHS) Classification Criteria for Acute Toxicity.

03 Sub Chronic Toxicity (OECD 407)



Types of dosage	Dosage (mg/Kg)
1	0
2	50
3	100
4	200

ECOTOXICITY STUDIES (OECD 203 and OECD 202)

ARTEMIA FRANCISCANA NAUPLII

DAPHNIA MAGNA

The EC50 value of Titanium Dioxide Nanoparticles at 48 hours was deduced to be > 100 mg/L under the present test conditions as no immobility and no abnormal behavior were recorded at the limit test of 100 mg/L.

Dimethylthiazol-diphenyltetrazolium bromide colorimetric assay

MTT CYTOTOXICITY ASSAY STUDIES

Mosmann (1983)

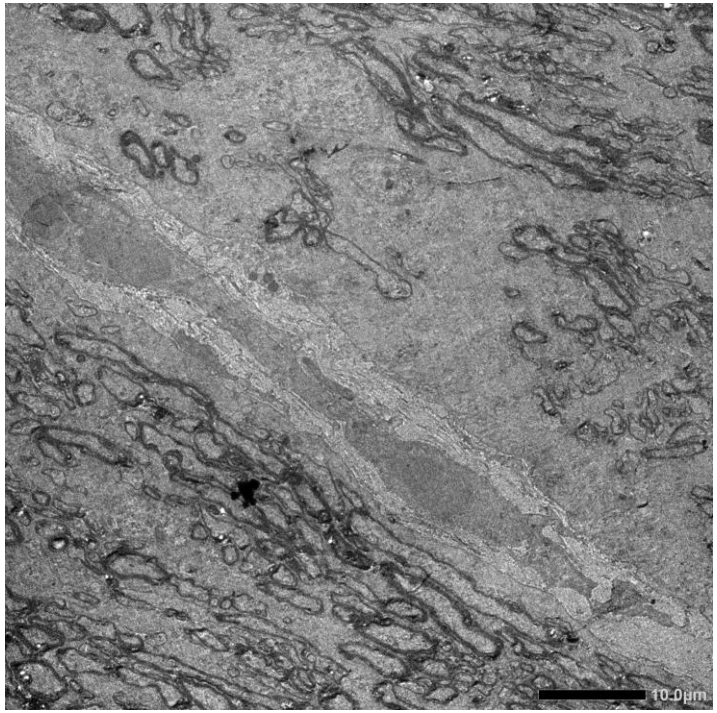
Sample	Activity
Nano TiO_2	Not Active

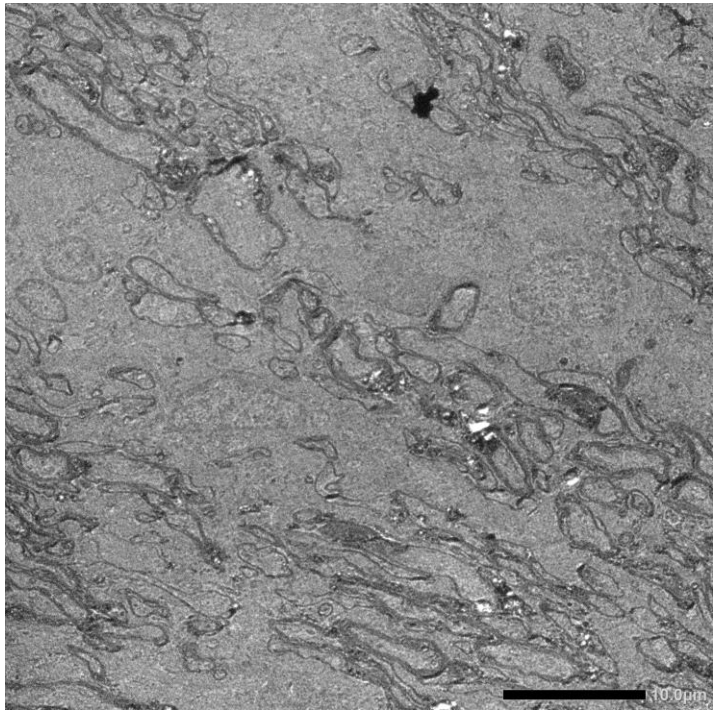
CELL LINE: AA8 – Chinese hamster ovarian

POSITIVE CONTROL: Doxorubicin

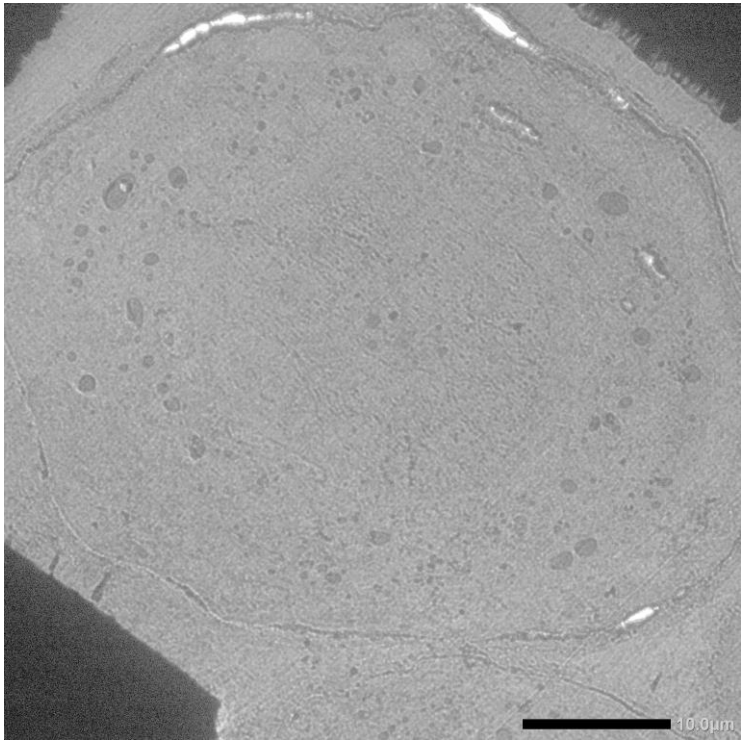
NEGATIVE CONTROL/SOLVENT: DMSO

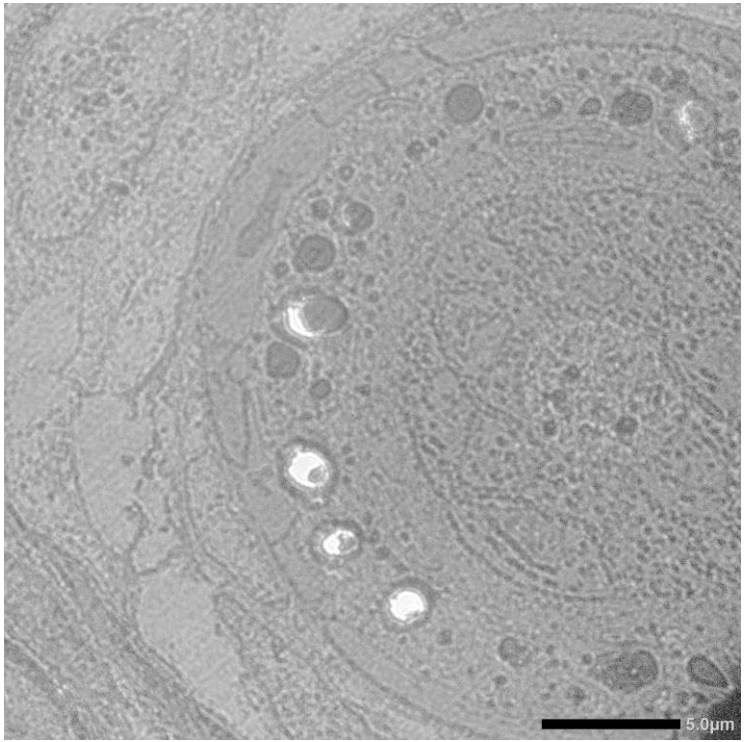
Optic nerve





Skin





EVALUATION OF RESULTS

- Based on the acute toxicity tests conducted on titanium dioxide nanoparticles, the GHS classification criteria is under category 5, which is the least toxic since no mortality was observed after 14 days at 5000 mg/kg bw (body weight) observation.

- Based on aquatic toxicity studies using nauplii and dapnia magna and MTT Cytotoxicity studies, titanium dioxide was found to be under Category Acute 3, which is non toxic to the environment.

FURTHER STUDIES

Toxicity Test

a. Acute/Sub-chronic Inhalation Test
b. Repeated 90-day Oral Toxicity

THANK YOU!

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GLOBALLY HARMONIZED SYSTEM (GHS) OF CLASSIFICATION CRITERIA FOR ACUTE TOXICITY

Acute Toxicity	Category 1	Category 2	Category 3	Category 4	Category 5
Oral (mg/kg)	≤ 5	>5 ≤50	>50 ≤300	>300 ≤2000	Criteria · Anticipated oral LD_{50} between 2000 and 5000 mg/kg · Indication of significant effect in humans · Any mortality at class 4 · Significant clinical signs at class 4 · Indications from other studies · If assignment to a more hazardous class is not warranted
Dermal (mg/kg)	≤50	>50 ≤200	>200 ≤ 1000	>1000 ≤2000	
Gases (ppm)	≤100	>100 ≤500	>500 ≤2500	>2500 ≤5000	
Vapors (mg/l)	≤0.5	>0.5 ≤2.0	>2.0 ≤10	>10 ≤20	
Dusts & Mists (mg/l)	≤0.05	>0.05 ≤0.5	>0.5 ≤1.0	>1.0 ≤5	

GLOBALLY HARMONIZED SYSTEM OF CLASSIFICATION AND LABELLING OF CHEMICALS

Hazard categories for substances hazardous to the aquatic environment

Category	Classification Limit
Acute 1 (very toxic)	≤ 1 mg / L
Acute 2	>1 - ≤ 10 mg / L
Acute 3	>10 - ≤ 100 mg / L

The criteria for classification of a substance in acute categories 1 to 3 are defined on basis of the acute toxicity data only (EC50 or LC50).
> 100 mg/L is considered as non-toxic to the environment.