

APPENDICES

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

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APPENDIX A

The Joint Committee for Powder Diffraction Standards (JCPDS) [65]

ZnO, JCPDS file number 01-075-0576Name and formula

Reference code: 01-075-0576

ICSD name: Zinc Oxide

Empirical formula: ZnO

Chemical formula: ZnO

Crystallographic parameters

Crystal system: Hexagonal

Space group: P63mc

Space group number: 186

a (?): 3.2427

b (?): 3.2427

c (?): 5.1948

Alpha (?): 90.0000

Beta (?): 90.0000

Gamma (?): 120.0000

Calculated density (g/cm³): 5.71Volume of cell (10⁶ pm³): 47.31

Z: 2.00

RIR: 5.53

Subfiles and Quality

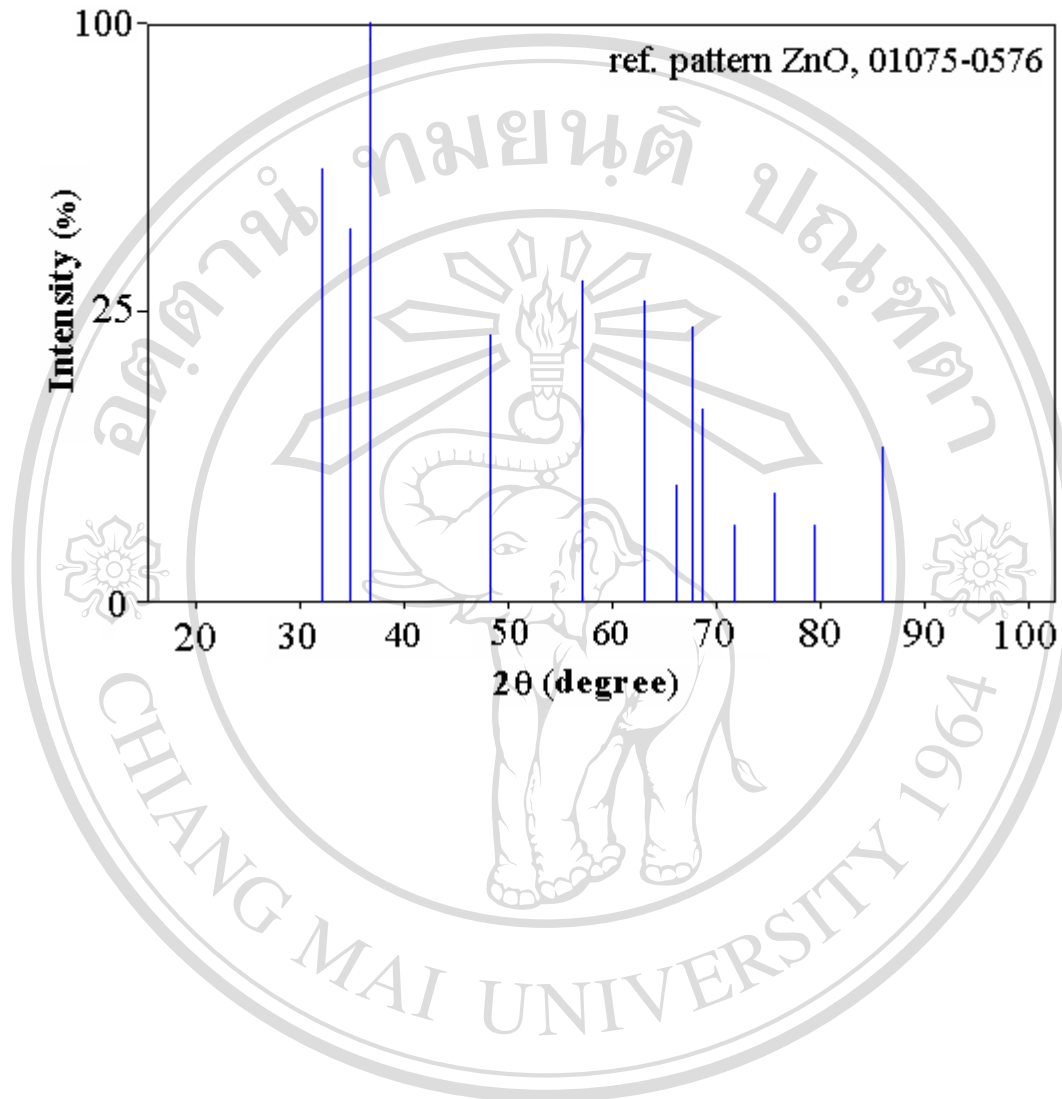
Subfiles:	Inorganic
	Alloy, metal or intermetallic
	Corrosion
	Modelled additional pattern
Quality:	Calculated (C)
<u>Comments</u>	
ICSD collection code:	029272
<u>References</u>	
Primary reference:	<i>Calculated from ICSD using POWD-12++, (1997)</i>
Structure:	Sabine, T.M., Hogg, S., <i>Acta Crystallogr., Sec. B</i> , 25 , 2254, (1969)

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Peak list

No.	h	k	l	d [Å]	2Theta[deg]	I [%]
1	1	0	0	2.80826	2.040	56.2
2	0	0	2	2.59740	2.206	41.2
3	1	0	1	2.47039	2.319	100
4	1	0	2	1.90683	3.005	21.5
5	1	1	0	1.62135	3.534	30.9
6	1	0	3	1.47393	3.888	27.2
7	2	0	0	1.40413	4.081	4.1
8	1	1	2	1.37538	4.167	22.7
9	2	0	1	1.35549	4.228	11.2
10	0	0	4	1.29870	4.413	1.8
11	2	0	2	1.23520	4.640	3.5
12	1	0	4	1.17875	4.862	1.8
13	2	0	3	1.09063	5.255	7.1

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Stick Pattern

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APPENDIX B

Material Safety Data Sheet [72]

Zinc oxide MSDS

Section 1: Chemical Product and Company Identification								
Product Name: Zinc oxide	Contact Information:							
Catalog Codes: SLZ1009, SLZ1114, SLZ1222, SLZ1057	Sciencelab.com, Inc. 14025 Smith Rd. Houston, Texas 77396							
CAS#: 1314-13-2	US Sales: 1-800-901-7247 International Sales: 1-281-441-4400							
RTECS: ZH4810000	Order Online: ScienceLab.com							
TSCA: TSCA 8(b) inventory: Zinc oxide	CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300							
CI#: Not available.	International CHEMTREC, call: 1-703-527-3887							
Synonym: Calamine; Zinc white	For non-emergency assistance, call: 1-281-441-4400							
Chemical Name: Zinc Oxide								
Chemical Formula: ZnO								
Section 2: Composition and Information on Ingredients								
Composition:								
<table border="1"> <thead> <tr> <th>Name</th> <th>CAS #</th> <th>% by Weight</th> </tr> </thead> <tbody> <tr> <td>Zinc oxide</td> <td>1314-13-2</td> <td>100</td> </tr> </tbody> </table>	Name	CAS #	% by Weight	Zinc oxide	1314-13-2	100		
Name	CAS #	% by Weight						
Zinc oxide	1314-13-2	100						
Toxicological Data on Ingredients: Zinc oxide: ORAL (LD50); Acute: 7950 mg/kg [Mouse].								
Section 3: Hazards Identification								
<p>Potential Acute Health Effects: Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion.</p> <p>Potential Chronic Health Effects: CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged exposure is not known to aggravate medical condition.</p>								

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation: Not available.

Ingestion:

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:

Risks of explosion of the product in presence of mechanical impact: Not available.

Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Slow addition of zinc oxide to cover linseed oil varnish causes generation of heat and ignition.

Special Remarks on Explosion Hazards:

May explode when mixed with chlorinated rubber.

Zinc Oxide and Magnesium can react explosively when heated.

Section 6: Accidental Release Measures

Small Spill:

Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:

Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:

Keep locked up. Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as acids.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 25°C (77°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection: Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

TWA: 5 STEL: 10 (mg/m³) from ACGIH (TLV) [United States] Inhalation

TWA: 15 (mg/m³) from OSHA (PEL) [United States] Inhalation Total.

TWA: 5 STEL: 10 CEIL: 25 (mg/m³) from NIOSH Inhalation

TWA: 5 STEL: 10 (mg/m³) from OSHA (PEL) [United States] Inhalation Respirable. Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Powdered solid.)

Odor: Odorless.

Taste: Bitter.

Molecular Weight: 81.38 g/mole

Color: White to yellowish-white

pH (1% soln/water): Not applicable.

Boiling Point: Not available.

Melting Point: 1975°C (3587°F)

Critical Temperature: Not available.

Specific Gravity: 5.607 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Is not dispersed in cold water, hot water.

Solubility:

Insoluble in cold water, hot water

Soluble in dilute acetic acid, or mineral acids, ammonia, ammonium carbonate, fixed alkali hydroxide solution..

Section 10: Stability and Reactivity Data
<p>Stability: The product is stable.</p> <p>Instability Temperature: Not available.</p> <p>Conditions of Instability: Not available.</p> <p>Incompatibility with various substances: Not available.</p> <p>Corrosivity: Non-corrosive in presence of glass.</p> <p>Special Remarks on Reactivity: Reacts violently with magnesium, linseed oil. Reacts with hydrochloric acid to produce zinc chloride. Reacts with sulfuric acid to produce zinc sulfate. Reacts with hydrogen fluoride to produce zinc fluoride tetrahydrate. Gradually absorbs CO₂ on exposure to air. Sublimes at normal pressure. Zinc Oxide reacts with Carbon Monoxide or hydrogen to produce elemental zinc.</p> <p>Special Remarks on Corrosivity: Not available.</p> <p>Polymerization: Will not occur.</p>
Section 11: Toxicological Information
<p>Routes of Entry: Dermal contact. Inhalation. Ingestion.</p> <p>Toxicity to Animals: Acute oral toxicity (LD₅₀): 7950 mg/kg [Mouse].</p> <p>Chronic Effects on Humans: MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast.</p> <p>Other Toxic Effects on Humans: Hazardous in case of inhalation. Slightly hazardous in case of skin contact (irritant), of ingestion.</p> <p>Special Remarks on Toxicity to Animals: Not available.</p> <p>Special Remarks on Chronic Effects on Humans: May cause adverse reproductive effects based on animal data. No human data found at this time. May affect genetic material (mutagenic).</p> <p>Special Remarks on other Toxic Effects on Humans: Acute Potential Health Effects: May cause mild skin irritation. Eyes: May cause mechanical eye irritation and conjunctivitis. Inhalation: May cause mechanical irritation of the respiratory tract. A few sources claim that finely divided zinc oxide dust can cause "metal fume fever." Zinc oxide dust is generally considered a nuisance dust; adverse effects are unlikely when exposures are kept under reasonable control. Inhalation of high concentrations of Zinc Oxide fume or dust may cause "Metal Fume Fever." Symptoms of metal fume fever may include a flu-like condition involving headache, chills, fever, sweats, nausea, vomiting, cough, muscle aches and pains, and difficulty breathing, pulmonary edema. May also affect the liver. Ingestion: May cause digestive tract irritation although Zinc oxide has a low toxicity by oral exposure route. Chronic Potential Health Effects: Ingestion: Prolonged or repeated ingestion of zinc oxide may affect blood, metabolism, and the thyroid.</p>
Section 12: Ecological Information
<p>Ecotoxicity: Not available.</p> <p>BOD₅ and COD: Not available.</p> <p>Products of Biodegradation: Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.</p> <p>Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.</p> <p>Special Remarks on the Products of Biodegradation: Not available.</p>

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:

Illinois toxic substances disclosure to employee act: Zinc oxide
Rhode Island RTK hazardous substances: Zinc oxide
Pennsylvania RTK: Zinc oxide
Minnesota: Zinc oxide
Massachusetts RTK: Zinc oxide
New Jersey: Zinc oxide
California Director's List of Hazardous Substances: Zinc oxide
TSCA 8(b) inventory: Zinc oxide

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC):

R40- Possible risks of irreversible effects.
S2- Keep out of the reach of children.
S36/37- Wear suitable protective clothing and gloves.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:

Gloves
Lab coat
Dust respirator. Be sure to use an approved/certified respirator or equivalent.
Safety glasses.

Section 16: Other Information

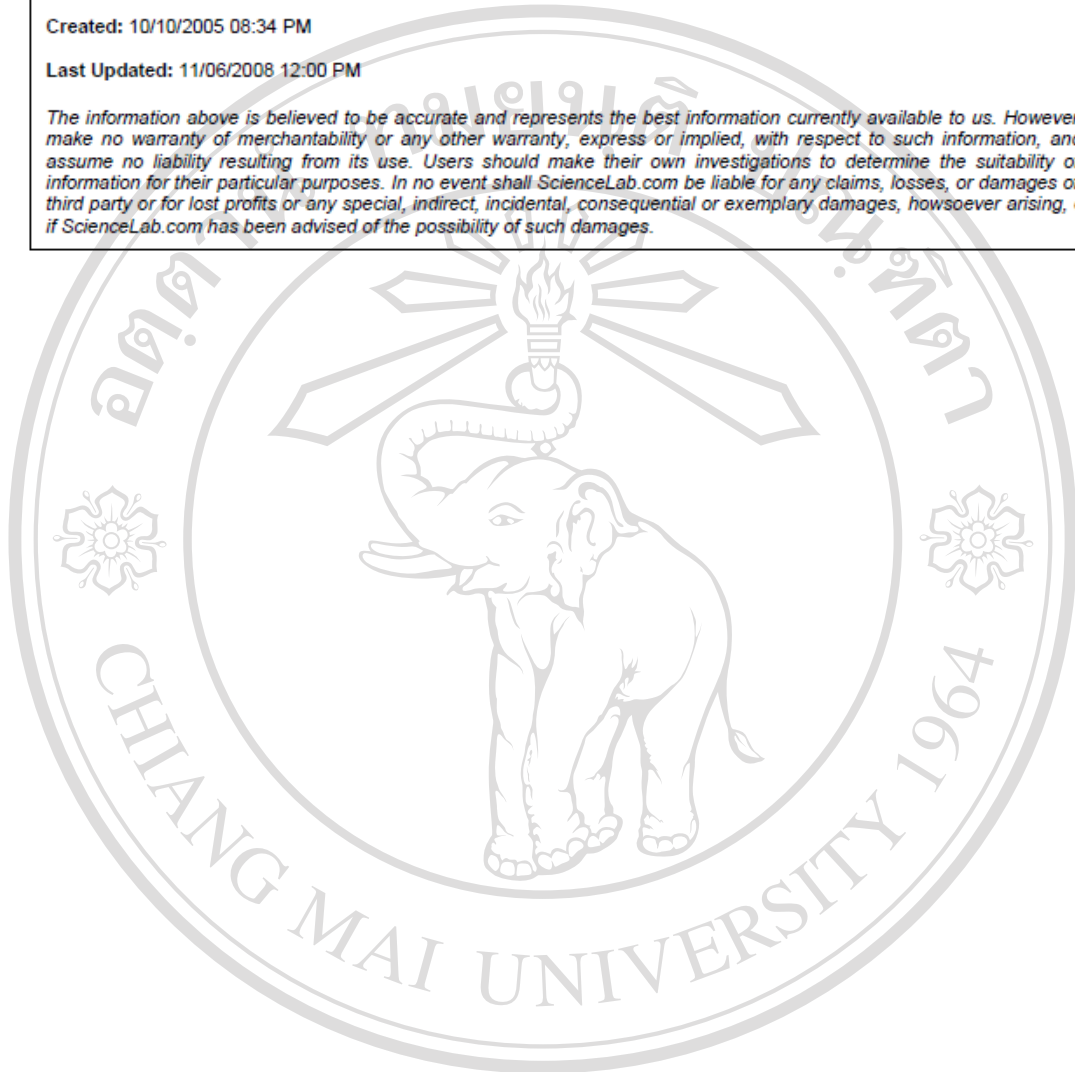
References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:34 PM

Last Updated: 11/06/2008 12:00 PM

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APPENDIX C

Camera constant used for the indexing of SAED pattern

Table appendix c. TEM constant ($L\lambda$) at 200 kV

L (cm)	$D_{111}\text{Au}$ (mm)	$r_{111}\text{Au}$ (mm)	$D_{111}\text{Au}_v$ (Å)	$L\lambda$ (mm.Å)
40	8.70	4.35	2.355	10.2442
60	13.2	6.60	2.355	15.5430
80	17.2	8.60	2.355	20.2530
100	21.2	10.60	2.355	24.9630
120	25.2	12.60	2.355	29.6730
150	31.5	15.75	2.355	37.0912
200	41.5	20.75	2.355	48.8662
250	51.8	25.90	2.355	60.9945

CURRICULUM VITAE

Name Miss Siriprapha Jattukul

Date of Birth 20 October 1984

Education Background

2007 - 2009 Master of Science (Inorganic Chemistry),
Chiang Mai University

2003 - 2007 Bachelor of Science (Chemistry),
Chiang Mai University

Scholarship

2006 - 2009 The Center for Innovation in Chemistry: Postgraduate
Education and Research Program in Chemistry (PERCH-CIC)

2003 - 2005 Thailand Science Scholarship Project.

2003 Thongkwaw Diamond Project

Experiences

2007 - 2008 Undergraduate Teaching Assistant, Chiang Mai University,

- General Chemistry Laboratory

- Chemistry Laboratory for Health Science

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