

Standard Operating Procedure (SOP) for (Cadmium Deposition)

PI Name: Yat Li

Date: 12/14/2012

Name of Lab or Unit: PSB 198

Review any applicable manufacturer/vendor safety information before developing Standard Operating Procedure (SOP) and append UC Approved Chemical SOP, if available, or SDS and other Chemical reference materials if UC Chemical SOP is not available.

#1	<p><u>Scope of Work/Activity:</u> Describe the experiment purpose/scope.</p> <p>Cadmium compounds are used to deposit onto titanium dioxide to form quantum dots. Possible compounds include: cadmium acetate, cadmium nitrate, cadmium selenide, cadmium sulfide, and/or cadmium telluride.</p> <p>Apparatus: electronic balance and chemical fume hood</p> <p>Procedure:</p> <ol style="list-style-type: none"> 1. Measure cadmium compound on balance 2. In fume hood: Add thiourea solution 3. In fume hood: Add ammonium hydroxide or sodium citrate solution 4. In water bath: Submerge TiO₂ substrate in solution at 55 deg. C 5. Transfer solution to waste container <p>Cadmium Compounds - CAS#: 543-90-8 (acetate), 10325-94-7 (nitrate), 1306-24-7 (selenide), 1306-23-6 (sulfide), 1306-25-8 (telluride)</p>
#2	<p><u>Specific Safety and Environmental Hazards:</u> State the specific hazard and consequences to person, environment, or property if procedure not followed.</p> <p>Cadmium compounds can cause acute and chronic adverse health effects. Cadmium is regulated by Cal/OSHA as a carcinogen.</p> <p>Cadmium compounds are toxic to aquatic organisms and may cause long-term adverse effects in the aquatic environment. Do not dispose of cadmium compounds down the drain.</p> <p>ACUTE TOXIN and CARCINOGENIC</p>
#3	<p><u>Describe in detail how the hazards will be controlled.</u></p> <p>a. Identify the Engineering Controls (e.g., fume hood, interlocks, shielding), work Practices or Procedures, or Personal Protective Equipment (e.g., gloves, respirator) that will be employed to reduce hazards to acceptable levels.</p> <p>All operations involving cadmium compounds should be carried out in a chemical fume hood with the sash in the down position, between your chest and what you are handling in the hood.</p> <p>Personal protective equipment should be obeyed according to section #5</p> <p>b. Address emergency shutdown procedures.</p>
#4	<p><u>Designated Area:</u> Indicate the area designated for performing this process in the laboratory.</p> <p>All the work involving cadmium compounds should be conducted in chemical fume hood.</p>

#5	<p>Personal Protective Equipment (PPE): State the personal protective equipment selected and required. Examples: safety glasses, goggles or face shield; lab coat; specific gloves; chemical-proof apron; respiratory protection.</p> <ol style="list-style-type: none"> 1. Chemical splash goggles 2. Disposable nitrile gloves <ul style="list-style-type: none"> • Immediately replace with new gloves when contamination occurs. 3. Lab coat 4. Closed-toed, impervious footwear
#6	<p>Important Steps to Follow: List the specific sequence of steps staff should follow to mitigate potentially hazardous conditions.</p> <ol style="list-style-type: none"> 1. Before handling, correctly calculate the amount needed. 2. Weigh the proper amount of solids via electronic balance. Do not spill solids on the balance. 3. Dissolve the solids into water in chemical fume hood.
#7	<p>Emergency / First Aid Procedures:</p> <ol style="list-style-type: none"> a. Describe immediate First Aid or medical treatment required in case of personnel exposure. -Complete incident report form (contact EH&S) <p>Eye or Skin Contact: Rinse under running water for 15 minutes. Seek immediate medical attention. Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention. Ingestion: Do not induce vomiting. Seek immediate medical attention.</p>
#8	<p>Training & Competency Requirements: Describe necessary training and demonstration of competency for performing the hazardous operation.</p> <ol style="list-style-type: none"> 1. Prior to conducting any work with cadmium compounds, designated personnel must provide training to his/her laboratory personnel specific to the hazards involved in working with this substance, work area decontamination, and emergency procedures. 2. The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and a copy of the cadmium compound MSDS provided by the manufacturer. Read MSDS and SOP before use. 3. The Principal Investigator must ensure that his/her laboratory personnel have attended the "Introduction to Laboratory Safety" training class and appropriate additional or refresher training within the last two years. 4. Each person using cadmium compounds must have completed the "Lab-Safety Training Checklist" with the PI or designee.
#9	<p>Identify hazardous waste(s) generated: List expected concentrations and amounts of hazardous waste(s) generated during this process. Contact EH&S for specific guidance regarding hazardous waste handling and disposal.</p> <p>Place solid waste in labeled solid waste container with hazardous waste tag complete. Waste solution containing cadmium compounds should be collected in liquid waste container with hazardous waste tag complete.</p>
#10	<p>Decontamination and spill clean-up procedures (reference embedded specific Chemical SOP as needed)</p> <p>Do not attempt to clean up any spill or release for which you are not fully trained and equipped. Contact 911 and ask for EH&S assistance for spill cleanup."</p>
#11	<p>Laboratory Emergency Response Equipment: All research personnel must know location of nearest fire alarm pull station and emergency shower/eyewash.</p> <ol style="list-style-type: none"> a. Note location and use of any emergency response equipment specific to process (e.g., Calgonate gel, Class D fire extinguisher)

As the Principal Investigator, it is your responsibility to ensure that all individuals conducting this protocol are taught the correct procedures for safe handling of the hazardous materials involved. It is also your responsibility to assure that your personnel complete Laboratory Safety Training and other applicable safety training courses.

I have reviewed and approve this Standard Operating Procedure.

1/9/2013

PI Signature:

DATE

Note that personnel associated with the protocol must sign the acknowledgement at the end of this document.

(Insert UC approved Chemical Specific SOPs/Lab Chemical Safety Summaries here)

Chemical Hazards and Controls

Cadmium Compounds

This is a Chemical Hazard and Control template and is not complete until: 1) Chemical specific information is entered into the boxes below 2) It is appended to the protocol/procedural SOP and 3) Complete SOP has been signed and dated by the PI and relevant lab personnel.

Print a copy and insert into your
Laboratory Safety Manual and Chemical Hygiene Plan with the Procedural SOP.
Refer to instructions for assistance.

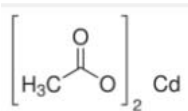
Department:	Chemistry
Date SOP was written:	12/13/12
Date SOP was approved by PI/lab supervisor:	Click here to enter text.
Principal Investigator:	Yat Li
Internal Lab Safety Coordinator/Lab Manager:	Tianyu Liu
Lab Phone:	Click here to enter text.
Office Phone:	(831) 459-1952
Emergency Contact:	Yat Li (Name and Phone Number)
Location(s) covered by this SOP:	PSB 198 (Building/Room Number)

Physical & Chemical Properties/Definition of Chemical Group

CAS#: 543-90-8 (acetate), 10325-94-7 (nitrate), 1306-24-7 (selenide), 1306-23-6 (sulfide), 1306-25-8 (telluride)

Class: **Toxic, carcinogenic**

Molecular Formula: Cd(CH₃COO)₂ (acetate)
Cd(NO₃)₂ (nitrate, anhydrous)



(cadmium acetate)

CdSe (selenide)
CdS (sulfide)
CdTe (telluride)

Molecular Weight: 266.53 (cadmium acetate)

Form (physical state): Cadmium acetate – powder, white
Cadmium nitrate- powder, white
CdSe (selenide)- granules, light grey
CdS (sulfide)- powder, yellow-orange
CdTe (telluride)- powder, white

Density: Click here to enter text

Color: white

Solubility: N/A

Boiling point: 765°C (acetate), 132°C (nitrate), n/a (selenide), 980°C (sulfide), 2066°C (telluride)

Melting point: N/A

Toxicity LD ₅₀ :	Cadmium acetate = 225 mg/kg (rat)	PEL = 5 ug/m ³	TWA = 2ug/m ³
	Cadmium nitrate = 100 mg/kg (mouse)	PEL = 5 ug/m ³	TWA = 2ug/m ³
	CdSe (selenide) > 5000mg/kg (rat)	PEL = 5 ug/m ³	TWA = 2ug/m ³
	CdS (sulfide) = 7080 mg/kg	PEL = 5 ug/m ³	TWA = 10 ug/m ³
	CdTe (telluride) = 2820 mg/kg (rat)	PEL = 5 ug/m ³	TWA = 2ug/m ³

Potential Hazards/Toxicity

Cadmium is an acute toxin and carcinogenic.

Cadmium is most efficiently absorbed through the respiratory tract, and may produce some irritation, cough, headache, or metallic taste. Severe exposures can produce shortness of breath, chest pain, and flu-like symptoms (metal fume fever) noting that inhalation symptoms can be delayed for up to 24 hours. Can cause nausea, vomiting, and diarrhea. Severe inhalation and ingestion can result in pulmonary edema, liver and kidney damage and death. Redness and pain can result from skin contact.

Minor but repeated exposure may result in chronic health and cumulative poisoning effects such as bone softening, increased blood pressure, kidney damage, anemia, pulmonary fibrosis, emphysema, and loss of smell. Cadmium is a cancer hazard, with increased prostate and lung cancer. **Cadmium has a permissible exposure limit (PEL) of 5 ug/m³.** NOTE: People with pre-existing skin or eye conditions or blood, prostate, liver, kidney or respiratory problems may be more sensitive to cadmium. Cadmium has a threshold limit value - time weighted average (TWA) of **2-10ug/m³.**

Personal Protective Equipment (PPE)

Respiratory Protection

Respirators should be used only under any of the following circumstances:

- As a last line of defense (i.e., after engineering and administrative controls have been exhausted).
- When there is a possibility that a Cal/OSHA Permissible Exposure Limit (PEL) or Action Level (AL) will be exceeded.
- Regulations require the use of a respirator.
- An employer requires the use of a respirator.
- There is potential for harmful exposure due to an atmospheric contaminant (in the absence of a PEL).
- As protective equipment during a chemical spill clean-up process (only when approved by EH&S).

Lab personnel intending to use a respirator must be trained and fit-tested by EH&S. This is a regulatory requirement. (<http://ehs.ucsc.edu/programs/safety-ih/respiratory-protection.html>)

Hand Protection

Wear disposal gloves (e.g., nitrile) when working with cadmium compounds.

NOTE: Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the cadmium compound to be used.

Refer to glove selection charts from the links below:

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf

OR

<http://www.allsafetyproducts.biz/page/74172>

OR

<http://www.showabestglove.com/site/default.aspx>

OR

<http://www.mapaglove.com/>

Eye Protection

ANSI approved properly fitting safety glasses or chemical splash goggles.

Skin and Body Protection

Flame resistant lab coats must be worn and be appropriately sized for the individual and buttoned to their full length. Laboratory coat sleeves must be of sufficient length to prevent skin exposure while wearing gloves. Personnel should also wear full length pants, or equivalent, and close-toed shoes. Full length pants and close-toed shoes must be worn at all times by all individuals that are occupying the laboratory area. The area of skin between the shoe and ankle should not be exposed.

Hygiene Measures

Wash thoroughly and immediately after handling. Remove contaminated clothing and wash before reuse.

Engineering Controls

Handle using a chemical fume hood with good ventilation and electrically grounded lines and equipment.

First Aid Procedures

If inhaled

Move into the fresh air immediately and give oxygen. If not breathing give artificial respiration. Get medical attention immediately.

In case of skin contact

Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

In case of eye contact

Check for and remove any contact lenses. Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician. Seek immediate medical attention and continue eye rinse during transport to hospital.

If swallowed

Do NOT induce vomiting unless directed by medical personnel. Never give anything by mouth to an unconscious person. Seek medical attention immediately.

Special Handling and Storage Requirements

To keep contamination to a minimum, all work with cadmium should be done in a properly designated area with secondary containment and proper labeling. Wash hands thoroughly after handling. Minimize the generation and accumulation of dust.

Avoid contact with eyes, skin, and clothing. Keep containers tightly closed. Store in a cool, dry and well-ventilated area away from incompatible substances.

Incompatible with the Following Materials

No data available.

Spill and Accident Procedure

Chemical Spill Dial 911

Spill– Dial **911** and ask for EH&S assistance or call EH&S directly x459-2553.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention if needed. *Notify supervisor and EH&S via 911 immediately.*

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. *Notify supervisor and EH&S via 911 immediately.*

Mucous Membrane Exposure: Flush the affected area for 15 minutes using an eyewash station.

Needlestick/Puncture Injuries – Wash the affected area with soap and warm water for 15 minutes. For employees, follow the instructions at the Risk Services website: <http://risk.ucsc.edu/workerscomp/injuryreportinghowto.html>

Medical Emergency Dial 911

Life Threatening Emergency, After Hours, Weekends And Holidays – Dial **911**

Non-Life Threatening Emergency– For employees, follow the instructions at the Risk Services website: <http://risk.ucsc.edu/workerscomp/injuryreportinghowto.html>

Note: All serious injuries must be reported to EH&S as soon as possible.

Decontamination/Waste Disposal Procedure

Contaminated instruments and benches should be decontaminated with soap and water. All waste and contaminated disposables should be disposed of as hazardous waste according to the guidelines below.

Waste Procedures

General hazardous waste management guidelines: <http://ehs.ucsc.edu/programs/waste-management/index.html>

Waste Labeling

- Affix an on-line hazardous waste tag on all waste containers using the Online Tag Program (OTP) <http://otp.ucop.edu/> as soon as the first drop of waste is added to the container.

Waste Storage

- Store hazardous waste in closed containers, in clean secondary containment, segregated by hazard class, in a marked and designated waste accumulation area.
- Double-bag dry waste using transparent bags.
- Waste accumulation area must be under the control of the person generating the waste.

Waste Disposal

- Hazardous waste must be removed from the lab within 180days.
- Containers must be clean, sealed, and safe to transport.
- Mark container as ready for pick up in OTP, move container to accumulation area.
- Contact EH&S at x9-3086 for questions

Safety Data Sheet (SDS) Location

Online SDSs can be accessed at: <http://www.ucmsds.com/?X>.

NOTE

Any deviation from this Procedural/Chemical Handling SOP requires approval from PI.

Documentation of Training (signature of all users is required)

- Prior to conducting any work with **Cadmium acetate, cadmium nitrate, Cadmium selenide, cadmium sulfide, cadmium telluride.**, the PI or designee must provide training to his/her laboratory personnel regarding the specific hazards involved in working with this substance, work area decontamination, and emergency procedures.
- The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and a copy of the SDS provided by the manufacturer.
- The Principal Investigator must ensure that his/her laboratory personnel have attended appropriate laboratory safety training or refresher training within the last year.

I have read and understand the content of this SOP:

Name	Signature	Date

(Add further signature lines as necessary)

Revision History

Version	Date	Revision Author	Summary of Changes
1	12/13/2012	Tianyu Liu	Initial SOP author
2	12/14/12	Lisa Wisser	Combination of all Cd SOPs into one, update chem info
3	12/17/12	Lisa Wisser	Review by Chemist, addition of PI/lab info
4	01/05/2013	Tina Ross	Chem Review, Edits

