UC | Center for Laboratory Safety

Standard Operating Procedure

Settlement Class: Pyrophorics

Organolithium Reagents

This SOP is not complete until it 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*.
Refer to instructions for assistance.

Department:	Chemistry & Biochemistry – Chemical Engineering
Date SOP was written:	December 14, 2012
Date SOP was approved by PI/lab supervisor:	January 18, 2013
SOP reviewed by:	Alessandro Moretto, Chem. Lab. Safety Officer
Principal Investigator:	Prof. Susannah Scott
Internal Lab Safety Coordinator/Lab Manager:	Stephanie Goubert-Renaudin
Lab Phone:	805- 893-8941
Office Phone:	805-893-7403
Emergency Contact:	EH&S 24 hour line: 805-893-3194
Location(s) covered by this SOP:	*ESB 3324 and 3328*

Type of SOP: ☐ Process ☐Hazardous Chemical ☒ Hazardous Class

Purpose

Organolithium reagents are pyrophoric organometallic compounds with the general formula RLi where R can be alkyls, aryls, and vinyls. Most organolithium reagents are highly pyrophoric substances and may spontaneously ignite in contact with air. These compounds have applications in organic synthesis since they are sufficiently strong bases to deprotonate many carbon acids, including benzene. In regard to molecular aggregation state, some of these compounds exist in clusters. These compounds can be used for the deprotonation of amines and activated C—H compounds.

Examples of Lithium reagents

Hexyllithium, (Trimethylsilyl)methyllithium, Butyllithium, Methyllithium

Physical & Chemical Properties/Definition of Chemical Group

CAS#: Various

Class: **Pyrophoric, can ignite in air**

Molecular Formula: RLi (R = Alkyl, Aryl, Vinyl)

Form (physical state): Solid, liquid

Color: Various

Boiling point: Various

Potential Hazards/Toxicity

Lithium reagents are pyrophoric. These compounds can spontaneously ignite in air. Please refer to the MSDS of the specific chemical for safe handling.

Personal Protective Equipment (PPE)

Respirator Protection
Use a full-face respirator with multi-purpose combination (US) respirator cartridges.

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 Permissible Exposure Limit (PEL) has exceeded or when there is a possibility that PEL 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 PEL)
- As PPE in the event of a chemical spill clean-up process

Lab personnel intending to use/wear a respirator mask must be trained and fit-tested by EH&S. This is a regulatory requirement.

Hand Protection
Handle with gloves. Nitrile gloves with a second layer of Silver shield gloves are recommended.

NOTE: Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with Lithium reagents.

Refer to glove selection chart 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, tight-fitting glasses/goggles.

Skin and Body Protection

Flame-resistant lab coat preferably made of antistatic material, long pants, closed-toe shoes.

Hygiene Measures
Avoid contact with skin, eyes, and clothing. Wash hands before breaks and after handling.

Engineering Controls

Organolithium reagents should be used in a glove box filled with inert gas, or in a certified fume hood using proper air-free techniques maintaining the pyrophoric solution under a blanket of inert gas.

Organolithium reagents MUST be kept under inert atmosphere (e.g. nitrogen, argon) at all times.

First Aid Procedures

If inhaled
Move person into fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Consult a physician.

In case of skin contact
Flush with plenty of water for at least 15 minutes while removing contaminated clothing. Consult a physician.

In case of eye contact
Flush eyes with plenty of water for at least 15 minutes lifting upper and lower eyelids and removing contact lenses. Consult a physician.

If swallowed
Do not induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Special Handling and Storage Requirements

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Never allow product to get in contact with water during storage. Handle and store under inert gas. Air sensitive. Avoid inhalation of vapor or mist. Keep away from sources of ignition. Take measures to prevent the buildup of electrostatic charge. Recommended storage temperature: 2 - 8 °C.

Spill and Accident Procedure

Chemical Spill Dial 9-911 and EH&S (805-893-3194)

Fire extinguisher
Do not extinguish with water. The recommended fire extinguisher is a standard dry powder (ABC) type. Class D extinguishers are recommended for combustible solid metal fires (e.g, sodium, LAH), but **not for organolithium reagents.**

Spill – Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

Small (<1 L) – If you have training, you may assist in the clean-up effort. Use appropriate personal protective equipment and clean-up material for chemical spilled. Double bag spill waste in clear plastic bags, label and take to the next chemical waste pick-up.

Large (>1 L) – Dial 9-**911** **from campus phones (and 805-893-3446 from a cell phone)** and EH&S (893-3194) for assistance.

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

Medical Emergency Dial 9-911

Life Threatening Emergency, After Hours, Weekends and Holidays – Dial 9-**911** (or 805-893-3446 from a cell phone) or go to the Emergency Room of Goleta Valley Cottage Hospital at 351 South Patterson Avenue, Goleta (Phone number: 805-967-3411) *Note: All Serious injuries must be reported to EH&S within 8 hours.*

Non-Life Threatening Emergency – Go to the Student Health Building, Building 588 (phone number: 893-5361, hours: M, T, R, F 8am-4.30pm, W 9am - 4.30pm, R 5pm to 7pm by appointment). After hours go to the Emergency Room of Goleta Valley Cottage Hospital at 351 South Patterson Avenue, Goleta (Phone number: 805-967-3411) *Note: All serious injuries must be reported to EH&S within 8 hours.*

Needle stick/puncture exposure (as applicable to chemical handling procedure) – Wash the affected area with antiseptic soap and warm water for 15 minutes. For mucous membrane exposure, flush the affected area for 15 minutes using an eyewash station. Page the needle stick nurse \ and then enter your extension. After hours go to the nearest emergency room: the Emergency Room of Goleta Valley Cottage Hospital at 351 South Patterson Avenue, Goleta (Phone number: 805-967-3411). *Note: All needle stick/puncture exposures must be reported to EH&S within 8 hours.*

Decontamination/Waste Disposal Procedure

Do not flush with water. Cover with dry sand or other non-combustible material. Call EH&S (805-893-3194) for assistance. Dispose as hazardous waste after quenching following the protocol/procedure and guidelines below.

General hazardous waste disposal guidelines:

Label Waste

- Affix an on-line hazardous waste tag on all waste containers as soon as the first drop of waste is added to the container

Store Waste

- Store hazardous waste in closed containers, in secondary containment and in a designated location
- Waste must be under the control of the person generating & disposing of it

Dispose of Waste

- Dispose of regularly generated chemical waste within 90 days
- Call EH&S for questions
- Empty Containers
    - Dispose as hazardous waste if it once held extremely hazardous waste (irrespective of the container size)
    - Consult waste pick-up schedule

Prepare for transport to pick-up location

- Check on-line waste tag
- Write date of pick-up on the waste tag
- Use secondary containment

Safety Data Sheet (SDS) Location

SDS can be found online: http://ehs.ucsb.edu/units/labsfty/labrsc/chemistry/lschemmsdsacc.htm

Protocol/Procedure

Please see attached SOP "Procedures for Safe Use of Pyrophoric Liquids"
(on line link: *http://web.chem.ucsb.edu/~moretto/SOP_Liquid_Reagents.pdf*)

Refer to the MSDS of the chemical for appropriate and safe handling.

Working with organolithium reagents is not allowed when alone in the Lab. Prior to starting reaction, locate the extinguisher, eyewash and safety shower.

Organolithium reagents are used as strong bases in our laboratory. They should be used in the nitrogen glove box or in the fume hood with proper air-free techniques for inert atmosphere (detailed below) maintaining them under a blanket of inert gas..

Organolithium reagents are sold as solutions in a solvent such as hexane, pentane, diethyl ether or tetrahydrofuran, and come bottles equipped with a septum (Sure/Seal packaging system). They are stored in the refrigerator.

Due to their pyrophoric nature, organolithium solutions are always handled wearing a flame retardant lab coat, safety goggles and nitrile gloves when handled out of the glove box.

All glassware and solvents should be dried prior to working with organolithium compounds.

When handled out of the glove box, proper needle and syringe techniques have to be used to transfer and dispense organolithium:

- ***Transferring organolithium solutions with a syringe***

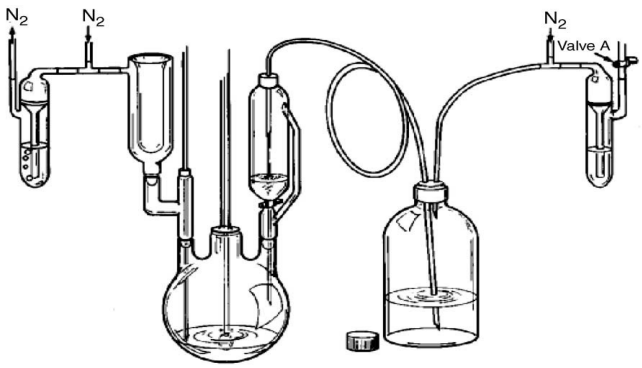
– Clamp the reagent bottle and receiving vessel to prevent them from moving.
- Insert a clean, dry needle from an inert gas source (such as Schlenk line) with a bubbler outlet into the bottle keeping the needle tip above the liquid level. This line is used to keep the reagent under a blanket of inert gas during the entire process.
- Flush a clean, dry syringe with the inert gas: to do so, pierce the septum, inert gas is drawn in to the syringe. Then remove the needle and expel the gas inside to the atmosphere. Repeat several times (commonly three times), piercing the same hole in the septum, to remove most air from the needle and syringe.
- Depress the plunger and insert the needle into the Sure/Seal bottle. Gently pull the plunger to draw liquid into the syringe. Pulling too hard or too fast can cause air bubbles to enter between the plunger and syringe body. Hold the end of the plunger as well as the joint where the needle and syringe meet. If these two parts come apart, the organolithium reagent will come out in air and ignite.

Syringe transfer of liquid reagent

• NOTES: Simple glass syringes are more prone to causing gas bubbles. Disposable plastic syringes have a good seal on the plunger and work well. Glass syringes with Teflon-tipped plungers (gastight) syringes are best. For safest work, do not fill syringe more than 60% full, up to a maximum of10 mL of liquid. The double-tipped needle technique is safer when transferring 10 mL or more.
- Excess reagent and entrained bubbles are then forced back into the reagent bottle; to do so you have to invert the syringe, and may have to carefully tilt the bottle.
- Quickly transfer the desired volume of reagent in the syringe to the reaction apparatus by puncturing a rubber septum and slowly dispensed.

- Transferring organolithium reagents with a Double-Tipped Needle

- The double-tipped needle technique is recommended when transferring 10 mL or more.
- Pressurize the Sure/Seal bottle with nitrogen and then insert the double-tipped needle through the septum into the headspace above the reagent. Nitrogen will pass through the needle.
- Insert the other end through the septum at the addition funnel on the reaction apparatus which must be equipped with a gas line to a bubbler. Push the needle into the liquid in the Sure/Seal reagent bottle and transfer the desired volume. Then withdraw the needle to above the liquid level.
- Allow nitrogen to flush the needle. Remove the needle first from the reaction apparatus and then from the reagent bottle.
- Alternatively, for an exact measured transfer, convey from the Sure/Seal bottle to a dry nitrogen flushed graduated cylinder fitted with a double-inlet adapter.
- Transfer the desired quantity and then remove the needle from the Sure/Seal bottle and insert it through the septum on the reaction apparatus. Apply nitrogen pressure as before and the measured quantity of reagent is added to the reaction flask.
- To control flow rate, fit a Luer lock syringe valve between two long needles.



Double-tipped needle transfer of liquid reagent

Cleaning lithium reagents from Needles and Syringes

- Needles and syringes used with pyrophoric reagents must be cleaned immediately to avoid clogging the needles and seizing the syringes.
- Draw hexane into the syringe containing small amounts of pyrophoric reagent and then discharge the diluted solution into isopropanol.
- Similarly, flush double-tipped needles with hexane and then quench hexane wash in isopropanol.
- To close the reagent bottle, simultaneously place a piece of parafilm over the hole formed by the needle while removing this needle from the bottle. Replace the cap and wrap the outside with parafilm to further ensure safe storage.

Quenching:

Small amounts of unused or unwanted organolithium reagent must be destroyed by careful quenching. Transfer the materials to an appropriate reaction flask for protonolysis and/or neutralization. Dilute significantly with an unreactive solvent such as heptane or toluene. Slowly add isopropanol to quench the organolithium. The flask can be placed in a cooling ice water bath. Upon completion, add methanol. Finally, slowly add water to make sure there are no pockets of reactive materials.

Dispose the non reactive solution as hazardous waste in the appropriate container, kept closed at all times.

NOTE: Any deviation from this SOP requires approval from PI.

Documentation of Training (signature of all users is required)

- Prior to conducting any work with Lithium reagents, designated personnel, i.e. approved users listed below, must provide training to his/her laboratory personnel specific to the 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 as required by EH&S.

I have read and understand the content of this SOP:

Name	Signature	Trainer	Date
Prof. Susannah Scott			
Stephanie Goubert-Renaudin			
Gary Kwanyi Ng			
Alessandro Gallo			
Anthony Crisci			
Haibo Yu			
Taeho Hwang			
Bethany Wigington			
Daniel Coller			
Zachary Jones			
Youhong Wang			
Jinghong Zhou			
Jason Fendi			