Standard Operating Procedure

NITRIC OXIDE

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
Locations covered by this SOP	ESB 3324 and 3328.

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

Purpose

Nitric oxide is an acutely toxic, poisonous, corrosive, high-pressure gas. It may be fatal if inhaled, can cause lung damage, can cause eye and skin burns, and vigorously accelerates combustion. Under ambient conditions NO is a colorless gas. Symptoms of exposure may be delayed. Nitric oxide is used for oxidation and reduction chemistry in flow reactors

Physical & Chemical Properties/Definition of Chemical Group

CAS#: 10102-43-9

Class: **Oxidizing agent, highly corrosive, combustible, acutely toxic**

Molecular Formula: NO

Form (physical state) Colorless gas Color: Colorless

Boiling point: -241.24°F (-151.80°C)

Potential Hazards/Toxicity

- Inhalation: Nitric oxide readily converts to nitrogen dioxide in air. Overexposure may irritate mucous membranes, sinuses, pharynx, and bronchia, causing pain, headache, cyanosis, irregular respiration, choking, dizziness, and possibly pulmonary edema (fluid in the lungs). There are often no pulmonary symptoms at time of exposure, but symptoms may appear within 5 to 72 hours. High vapor concentrations may cause pain, choking, bronchoconstriction, reflex slowing of the heart, and possibly asphyxiation.
- Skin contact: Severe irritant; may cause burns
- Eye Contact. May cause severe conjunctivitis, producing marked redness and swelling of the conjunctiva. May cause corneal injury with opacification.

Personal Protective Equipment (PPE)

Eye Protection

ANSI approved safety glasses or goggles.

Skin and Body Protection

- A lab coat

Hygiene Measures

- Wear long pants, shirt, and closed toe shoes and a lab coat while handling.

Respirators

- *Respirators:* Respiratory protection is not generally required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant respirator use.

Engineering Controls

Use only with adequate ventilation.

First Aid Procedures

If inhaled
Immediately remove to fresh air. If not breathing, give artificial respiration. Call a physician
In case of skin contact
Immediately flush skin with plenty of water for at least 15 minutes while
removing contaminated clothing and shoes. Discard clothing and shoes. Call a physician.
In case of eye contact
Immediately flush eyes thoroughly with cool water for at least 15 minutes.
Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed
thoroughly. See a physician, preferably an ophthalmologist, immediately.
If swallowed
An unlikely route of exposure. This product is a gas at normal temperature and pressure.

Special Handling and Storage Requirements

Handling

May be fatal if inhaled. Do not breathe gas. High pressure gas. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Store in tightly-closed container. Avoid contact with combustible materials. Protect

cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. Never insert an object (e.g., wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps.

Storage

Keep container tightly closed. Keep container in a cool, well-ventilated area, away from oil, grease, and other flammable materials. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Must be secured with chains.

Accident: Dial 9-911 and EH&S (805-893-3194)

Spill – If the cylinder or line is leaking uncontrollably, evacuate the area. 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

When the nitric oxide compressed gas cylinder is empty, remove any attachments from the valve, cap the cylinder, and mark “empty” on the cylinder. Vent the regulator in a fume hood prior to removing. Return empty cylinder to manufacturer.

Safety Data Sheet (SDS) Location

Online SDS can be accessed at http://ehs.ucsb.edu/units/labsfty/labrsc/chemistry/lschemmsds.htm

Protocol/Procedure

In our laboratory, nitric oxide is used in various reactors such as a plug flow reactor.

When the cylinder is not in use, it should be capped and stored in a well ventilated area such as a gas cabinet.

Wear proper PPE (safety goggles and lab coat) at all times when working with nitric oxide.

Ensure that NO is used in a well-ventilated area, preferably in a fume hood or contained within a reactor in a glovebox. The regulator and all fittings and connections must be leak checked with snoop (soapy water) because the cylinder cannot be positioned inside the fume hood or glovebox. Snoop (soapy water) will bubble if there is a gas leak; tighten the fittings if there is a leak. All users should be familiar with attaching regulators, fittings, and leak checking connections or they should be accompanied by someone with experience.

The cylinder should always be securely fastened so that it cannot fall over. Avoid ignition sources. Nitric oxide is used in a closed system in the glove box to avoid exposure. All vents are securely connected to the main exhaust lines to prevent gas exposure in the laboratory.

When the cylinder pressure is too low, the cylinder should be labeled and returned to the distributor.

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 nitric oxide, 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			