Standard Operating Procedure

10% Nitrogen Dioxide + 90% Nitrogen Gas

This is an SOP template and is not complete until: 1) lab specific information is entered into the box below 2) lab specific protocol/procedure is added to the protocol/procedure section and 3) SOP has been signed and dated by the PI and relevant lab personnel.

Print a copy and insert into your *Lab-Specific Chemical Hygiene Plan*.

Section 1 – Lab-Specific Information

Building/Room(s) covered by this SOP:	706
Department:	Chemical Engineering
Principal Investigator Name:	Zhiqiang Niu

Section 2 – Hazards

Nitrogen dioxide is a reddish-brown gas with a strong odor. Nitrogen Dioxide can affect you when breathed in. Nitrogen Dioxide may cause mutations. Handle with extreme caution. Contact can irritate and burn the skin and eyes with possible eye damage. Breathing nitrogen dioxide can irritate the nose and throat. Breathing nitrogen dioxide can irritate the lungs causing coughing and/or shortness of breath. Higher exposures can cause a build-up of fluid in the lungs (pulmonary edema), a medical emergency, with severe shortness of breath. High levels can interfere with the ability of the blood to carry oxygen causing headache, fatigue, dizziness, and a blue color to the skin and lips (methemoglobinemia). Higher levels can cause trouble breathing, collapse and even death. Repeated exposure to high levels may lead to permanent lung damage. Nitrogen dioxide will react with WATER to form Nitric Acid. Nitrogen dioxide may react explosively with TRIMETHYLTIN; TRIETHYLAMINE; AMMONIA; ALCOHOLS; ACETONITRILE; INDIUM; METHYL SULFOXIDE; HYDRAZINES; ALUMINUM POWDER; and CARBON DISULFIDE. Nitrogen Dioxide is not compatible with COMBUSTIBLE MATERIALS; CHLORINATED HYDROCARBONS; FORMALDEHYDE; FLUORINE; PETROLEUM; NITROBENZENE; COPPER; COPPER ALLOYS; and REDUCING MATERIALS. Store in tightly closed containers in a cool, dry, well-ventilated area.

Section 3 – Engineering Controls and Personal Protective Equipment (PPE)

Engineering Controls: Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.

Hygiene Measures: Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Hand Protection: Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Eye Protection: Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles and/or face shield. If inhalation hazards exist, a full-face respirator may be required instead.

Skin and Body Protection: Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory Protection: Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 4 – Special Handling and Storage Requirements

Safety can be achieved while handling 10% nitrogen dioxide + 90% nitrogen gas by adhering to the below mentioned protocols, *but not limited to the following*;

Protective Measures: Put on appropriate personal protective equipment. Contains gas under pressure. Do not get in eyes or on skin or clothing. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement. Empty containers retain product residue and can be hazardous. Keep away from clothing, incompatible materials and combustible materials. Do not breathe gas. Keep reduction valves free from grease and oil.

Advice on General Occupational Hygiene: Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas.

Conditions for safe storage, including any incompatibilities: Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials. Store locked up. Separate from reducing agents and combustible materials. Store away from grease and oil. Keep container tightly closed and sealed until ready for use. 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).

Section 5 – Spill and Accident Procedures

In the event of a 10% nitrogen dioxide + 90% nitrogen gas leak, take the following immediate actions:

- Evacuate the Area: Quickly evacuate personnel from the affected area to prevent nitrogen dioxide exposure. Ensure that individuals move to a well-ventilated location.
- Ventilation: Increase ventilation in the area by opening doors and windows or using mechanical ventilation systems to disperse the gas.
- Emergency Shutoff: If safe to do so, close the valve on the leaking nitrogen dioxide tank or cylinder to stop the flow of gas. Use appropriate tools and PPE to avoid injury.
- Alert Emergency Services: Contact emergency services and report the incident, providing details about the location, the amount of nitrogen dioxide released, and any potential injuries.
- First Aid: Provide first aid to anyone who has been exposed to nitrogen dioxide. Move the affected person to fresh air, monitor their breathing, and provide CPR if necessary. Seek medical attention immediately.

Section 6 – Waste Disposal Procedures

The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty pressure vessels should be returned to the supplier. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 7 – Protocol (Add lab specific Protocol here)

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NOTE: Any deviation from this SOP requires approval from Principal Investigator.

Section 8 – Documentation of Training (signature of all users is required)

Prior to conducting any work with 10% nitrogen dioxide + 90% nitrogen gas, the Principal Investigator must ensure that all laboratory personnel receive training on the content of this SOP.

I have read and understand the content of this SOP:

Name	Signature	Date
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