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| **Brueckner Lab-Specific Standard Operating Procedure (LSOP)****Boron Tribromide (BBr3)** |
| **Principal Investigator(PI):** Christian Brueckner |
| **Building:** Chemistry | **Lab(s) Covered by LSOP:** R413/R415 |
| **Department:** Chemistry | **Lab Phone Number(s):** 6-6596/6-6598 |
| **Boron tribromide (BBr3)** |  | **Acute toxicity** – adverse effects occurring following oral or dermal administration of a single dose of a substance.**Skin corrosion** – is the production of irreversible damage to the skin; namely, visible necrosis through the epidermis and into the dermis.**Flammable.** Pyrophoric liquids. |
| **SECTION 1 – HAZARDOUS CHEMICAL(S) or PROCESS(ES) and HAZARDS INVOLVED** |
| Boron tribromide (BBr3) is a dark red and readily volatile liquid that is corrosive and can severely burn and irritate the skin and eyes upon contact. Inhalation of BBr3 is very hazardous and may cause irritation of the nose, throat, and lungs, leading to coughing and shortness of breath. Prolonged exposure may cause pulmonary edema. BBr3 reacts violently when in contact with water, potassium, sodium, and alcohols. Upon exposure to air, BBr3 evolves to boronic acid and HBr explosively and may catch fire. BBr3 is not compatible with oxidizing agents, strong acids or bases, ethers, phosphorus, or alkali metals. Reaction vessels must be dried before addition of BBr3 to avoid moisture contact. Any fires are to be extinguished with a dry chemical or CO2. |
| **SECTION 2 – ADMINISTRATIVE CONTROLS** |
| * Anyone using BBr3 needs to have undergone the annual EH&S [Chemical Hygiene Training.](http://www.ehs.uconn.edu/Chemical/?p=training)
* Be aware of the applicable safety data sheets (SDS): [http://www.msds.com.](http://www.msds.com)
* [Working Alone](http://policy.uconn.edu/2012/07/30/working-alone-policy/) is not permitted when using chemicals or processes described in this LSOP.
* A second person, in full PPE and trained in the use of BBr3, needs to be present when a BBr3 reaction is begun, when BBr3 is being transferred, and when a large scale (>50 mL total volume) reaction is being quenched.
* Any reaction flask containing BBr3 needs to be clearly labelled as such.
* BBr3 reactions must be performed during normal business hours (i.e., 8:00 am-5:00 pm Mon-Fri).
* An unobstructed eyewash and safety shower must be in the immediate work area.
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| **SECTION 3- ENGINEERING CONTROLS** |
| * All research with BBr3 must be conducted in a chemical fume hood, under dry conditions, with the sash at the lowest working height and with sliding sash panels (if applicable) aligned to form a barrier between the researcher and the experiment.
* Chemical fume hoods must have been tested by EH&S within the last year. If hood is not working properly, contact Facilities (860-486-3113) to repair the hood and EH&S to retest (860-486-3613).
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| **SECTION 4 – WORK PRACTICES** |
| BBr3 must be handled in a dry place. Keep cool and protect from sunlight.All containers must be clearly labeled with the chemical name and hazard classes and kept tightly-sealed.Empty containers of BBr3 must be handled carefully since product residues may still be harmful. Do not submit the empty bottle to the stockroom without washing it – be very careful! Leave all contaminated glassware in the fume hood for at least a day but rinse glass syringes etc. under a vigorous stream of cold water immediately after use. Leave the sink running with cold water while doing BBr3 reactions to be able to rinse contaminated material asap. All reactions involving the transfer of BBr3 need to go through a dry run.All reactions involving BBr3 need to be thoroughly quenched before they can leave the fumehood or be put on the rotary evaporator.All reactions involving BBr3 need to be clearly labelled as such. |
| **SECTION 5 – PERSONAL PROTECTIVE EQUIPMENT (PPE)** |
| * At a minimum, a lab coat, long pants as well as closed-toed footwear and chemical safety glasses, that meet American National Standards Institute (ANSI) standard Z-87.1 must be worn when handling BBr3.
* Chemical splash goggles or full-face shield are required when more than 5 mL BBr3 is involved.
* Nitrile Gloves must be worn while handling BBr3 though be aware that they burn/melt as soon as BBr3 catches fire on them!
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| **SECTION 6 – STORAGE** |
| * Store BBr3 as indicated in safety data sheet (SDS): [http://www.msds.com/.](http://www.msds.com/)
* Ensure labels on original bottles remain legible and prominently displayed to identify contents.
* Ensure both original and secondary containers remain intact and are stored with tight-fitting caps or lids.
* Store opened (but tightly sealed) BBr3 bottle in the chemical fridge in R413.
* If the bottle cap looks cracked or corroded, dispose of the entire bottle through EH&S, or by following their guidelines, and order a new one.
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| **SECTION 7 – SPILL AND ACCIDENT PROCEDURES** |
| * In case of a spill of more than a few drops of BBr3 outside of the fume hood, move away from the area, let your labmates know, and evacuate the laboratory immediately, as needed.
* Close door(s) to lab and post a “**NO ENTRY**” sign(s) explicitly mentioning the type of hazard.
* Small amounts of a BBr3 spill can be covered with sand and left alone.
* In case of a large (>20 mL) spill outside the fume hood, activate the fire alarm and call **911**.
* Do not re-enter area until instructed to do so by an emergency personnel.

**Report any incident to the PI and fill out the** [**accident form**](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwiF3bPe1dPXAhVRRN8KHX4wDf4QFggmMAA&url=https%3A%2F%2Fchemistry.uconn.edu%2Fwp-content%2Fuploads%2Fsites%2F1259%2F2015%2F09%2FIncident-Report-Form.doc&usg=AOvVaw3Uov8IQ2Z-Kan) |
| **SECTION 8 – FIRST AID PROCEDURES** |
| *Eyes** Immediately move to the eyewash station, hold eyelids open and flush with water. Remove contact lenses while flushing (if applicable).
* Have another person from the lab dial **911** and specifically mention BBr3 exposure.
* Continue flushing the eyes until emergency personnel arrive.

*Skin** Immediately move to safety shower or other water source and begin rinsing affected area(s). Remove contaminated clothing (if applicable) while flushing.
* Have another person from the lab dial **911** if intense skin irritation is observed and specifically mention BBr3 exposure.
* Keep applying a dil. aqueous sodium bicarbonate solution or rinsing affected area(s) with water until emergency personnel arrive.

*Ingestion** Immediately rinse the mouth with cold water.
* Do NOT induce vomiting.
* Have another person from the lab dial **911** and specifically mention BBr3 exposure.

*Inhalation** Move to fresh air.
* Dial **911** and inform emergency responders that the accident involved BBr3.

**Report any incident to the PI and fill out the** [**accident form**](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwiF3bPe1dPXAhVRRN8KHX4wDf4QFggmMAA&url=https%3A%2F%2Fchemistry.uconn.edu%2Fwp-content%2Fuploads%2Fsites%2F1259%2F2015%2F09%2FIncident-Report-Form.doc&usg=AOvVaw3Uov8IQ2Z-Kan) |
| **SECTION 9 – WASTE MANAGEMENT** |
| * All waste must be labeled with “Hazardous Waste” stickers or tags, use full chemical names to describe the waste (i.e., no chemical abbreviations or symbols), be stored in sturdy containers with tight-fitting caps or lids, and be stored alone or with other compatible chemicals.
* Hazardous wastes must be stored at or near a green “Satellite Accumulation Area” sign prior to disposal by EHS. Once the containers are 80% filled, fill our EH&S chemical [waste pickup form.](http://ehs.uconn.edu/Regulated%20Waste%20Management/index.php)
* The [Chemical Waste Disposal Manual](http://ehs.uconn.edu/Chemical/ChemWasteDisp.pdf) must be used as a reference.
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| **SECTION 10 – DECONTAMINATION PROCEDURES** |
| Work Area | * Equipment can be decontaminated through rinse with copious amounts of water; use of surfactants is recommended.
* Let contaminated material react off with the humidity in the air under the fume hood.
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| Personal Hygiene | * Use standard chemical hygiene practices regarding PPE (see above).
* Wash hand thoroughly after handling BBr3.
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| **SECTION 11 – SPECIFIC PROCEDURE** |
| A representative procedure is, for example, described in Caulder, D. L.; Brückner, C.; Powers, R. E.; König, S.; Parac, T. N.; Leary, J. A.; Raymond, K. N. ‘Design, Formation and Properties of Tetrahedral M4L4 and M4L6 Supramolecular Clusters’ *J. Am. Chem. Soc.* **2001**, *123*, 8923–8938.*General Procedure for the Formation of the Ligands* ***H6A****,* ***H4B****, and* ***H4C****.* A four-fold stoichiometric excess per methoxy group of BBr3 was added at -78 °C via syringe to a solution of the protected ligands **Me6A**, **Me4B**, and **Me4C** in dry CH2Cl2 (100 mL/5 mmol ligand). The reaction mixture was allowed to warm to room temperature and stirred overnight. Workup procedure A: Volatiles were removed under vacuum, and the remaining residue was suspended in water for 2 h at 100 °C. The white precipitates were collected by filtration and dried under vacuum at 70 °C. Workup procedure B: Unreacted BBr3 was quenched by the careful addition of MeOH. The mixture was distilled while repeatedly adding portions of fresh MeOH until the distillate were boron-free (flame test: one drop of the distillate when lit on a cotton swap does not burn green). The products precipitated as crystalline material from the reduced hot methanolic solution were filtered off and dried. |

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| **SECTION 12A. APPROVAL** |
| I have reviewed, understand and agree to follow this lab-specific standard operating procedure (LSOP) for the use of BBr3*.* Failure to follow this LSOP or lab-specific training guidelines is a violation of the [*University Health & Safety Policy*](http://policy.uconn.edu/2011/05/19/health-and-safety-policy/) and [*University Code of Conduct*](http://policy.uconn.edu/2011/05/17/employee-code-of-conduct/).Further approval and/or review of this LSOP by the PI is required if any of the following events occur:* A significant change in amount (i.e., doubling of the scale of reaction) or substitution of the chemicals in the procedure is planned.
* A major change in the agreed-upon experimental set-up is planned (heating instead of room T, etc.).
* Any signs of a failure in safety design or equipment are observed.
* Any signs or symptoms of a chemical exposure to any personnel are observed.
* Unexpected and/or potentially dangerous experimental results occur (e.g., fire, uncontrolled buildup of heat and/or pressure, etc.).
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| **Researcher Name/Signature** | **Trainer Name/Signature** | **Training Date** |
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| **SECTION 12B. PRINCIPAL INVESTIGATOR CERTIFICATION** |
| I approve the contents of the lab-specific standard operating procedure listed above. |
| **PI Signature:** | **Date:** |
| **A HARD OR ELECTRONIC COPY (https://bruckner.research.uconn.edu/safety-resources/) OF EACH LAB-SPECIFIC STANDARD OPERATING PROCEDURE MUST BE READILY AVAILBALE IN THE LAB.** |