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| **Brueckner Lab-Specific Standard Operating Procedure (LSOP): Trifluoroacetic Acid (TFA)** |
| **Principal Investigator(PI):** Christian Brueckner |
| **Building:** Chemistry | **Lab(s) Covered by LSOP:** R413/R415 |
| **Department:** Chemistry | **Lab Phone Number(s):** 6-6596/6-6598 |
| **Chemical** | **GHS Pictograms** | **Definitions** |
| **Trifluoroacetic acid (CF3CO2H)** |  | **Corrosive**: causes irreversible damage to living tissue. **Acutely toxic**: adverse effects occurring following oral or dermal administration of a single dose of a substance, or multiple doses given within 24 hours, or an inhalation exposure of 4 hours. |
| **SECTION 1 – HAZARDOUS CHEMICAL(S) or PROCESS(ES) and HAZARDS INVOLVED** |
| Trifluoroacetic acid (TFA) is a colorless, volatile and highly corrosive liquid of smell only vaguely reminiscent of acetic acid. Contact with the skin, eyes, or mucous membranes can result in severe burns and ingestion can cause severe damage to the digestive tract. TFA vapor is highly irritating to the eyes and respiratory tract, and inhalation of high concentrations can lead to severe destruction of the upper respiratory tract and may be fatal as a result of pulmonary edema. Symptoms of overexposure include coughing, headache, nausea, vomiting, and an overall ‘burning’ feeling. It has not been found to show carcinogenic, reproductive, or developmental toxicity towards humans. |
| **SECTION 2 – ADMINISTRATIVE CONTROLS** |
| * Anyone using the chemicals and procedures described herein 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 (MSDS): [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.
* An eyewash and safety shower must be in the immediate work area where TFA is used.
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| **SECTION 3- ENGINEERING CONTROLS** |
| * All research with TFA must be conducted in a chemical fume hood, 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 EHS within the last year. If the hood is not working properly, contact Facilities (860-486-3113) to repair the hood or EHS to retest (860-486-3613).
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| **SECTION 4 – WORK PRACTICES** |
| TFA must be handled and stored in a dry place. Keep away from incompatible materials (bases, hydrides, metals that are readily corroded). Keep cool.All containers must be clearly labeled with the chemical name and hazard classes and kept tightly-sealed. Empty containers must be handled carefully since product residues (vapors, liquid) are still harmful; rinse bottle before submitting for disposal. |
| **SECTION 5 – PERSONAL PROTECTIVE EQUIPMENT (PPE)** |
| * At a minimum, a properly fitting lab coat, long pants and closed-toed footwear, and chemical safety glasses that meet American National Standards Institute (ANSI) standard Z-87.1 must be worn when handling TFA.
* Nitrile Gloves must be worn while handling TFA.
* The use of splash goggles is recommended when handling larger quantities (>100 mL) of TFA.
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| **SECTION 6 – STORAGE** |
| * Store TFA 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.
* Keep container closed when not in use.
* Store in a cool, dry, well-ventilated area away from incompatible substances (acid cabinet under fume hood in R415).
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| **SECTION 7 – SPILL AND ACCIDENT PROCEDURES** |
| * Alert everyone in the laboratory immediately upon spills of more than a few mL of TFA outside the fume hood.
* Close door(s) to lab and post a “**NO ENTRY**” sign(s) explicitly mentioning the type of hazard on the door.
* Absorb spill with inert material (e.g. vermiculite or sand) if it is safe to do so, then place in suitable container.
* Evacuate the laboratory and activate the fire alarm and call **911** in case of a large (>50 ml pure TFA) spills outside the fume hood.
* Do not re-enter area until instructed to do so by 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.
* Have another person from the lab dial 911 and specifically mention TFA exposure.
* Continue flushing the eyes until emergency personnel arrives.

*Skin** Immediately move to safety shower or other water source and begin rinsing affected area(s). Remove contaminated clothing (if applicable) while flushing.
* If skin irritation is noted, have another person from the lab dial 911 and specifically mention TFA exposure.
* Keep rinsing affected area(s) until emergency personnel arrives.

*Ingestion** Immediately rinse the mouth with cold water; if victim is fully conscious, give a cupful of water.
* Do NOT induce vomiting.
* Have another person from the lab dial 911 and specifically mention TFA exposure.

*Inhalation** Move to fresh air.
* If not breathing, give artificial respiration.
* Dial 911 and specifically mention TFA exposure.

**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 TFAwaste must be labeled with “Hazardous Waste” stickers or tags, use full chemical names to describe the waste (i.e., no chemical abbreviations or symbols).
* Must be stored in sturdy glass or plastic 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 EH&S. 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 a water or dil. aq. bicarbonate rinse.

**Personal Hygiene*** Use standard chemical hygiene practices regarding PPE (see above).
* Wash hand thoroughly after handling TFA.
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| **SECTION 11 – SPECIFIC PROCEDURE** |
| 1. Typically, we use TFA as the standard acid for the acidification of UV-vis samples using a drop of a 1-10% TFA solution in CH2Cl2.
2. A typical use of TFA as acid catalyst is described in: Jiang T.; Gan B.; Wang X.; Zhang X. ‘One-pot synthesis of *ortho*-acylphenols by palladium-catalyzed phenol C–H addition to nitriles’ *Tetrahedron Lett.* **2017**, 58, 4197–4199.

*General Procedure for the Acylation of Phenols with Nitriles*A mixture of phenol **1** (0.2 mmol), nitrile **2** (0.3 mmol, if acetonitrile (0.5 mL) was used only), Pd(OAc)2 (4.4 mg, 0.02 mmol), DMSO (28.4 µL, 0.4 mmol), TFA (0.2 mL) and H2O (0.1 mL) in DCE (0.5 mL) was stirred at 120 °C for the indicated time (see Table 2). After the reaction was finished, the mixture was concentrated under reduced pressure. The residue was purified by flash column chromatography on a silica gel using petroleum ether/EtOAc as the eluent to give the desired product **3**. |

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| **SECTION 12A. APPROVAL** |
| I have reviewed, understand and agree to follow this lab-specific standard operating procedure (LSOP) for TFA*.* 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/Supervisor 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 temp, 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.** |