

Citric Acid – Phosphoric Acid – Hydrogen Peroxide – Water (Citric:H3PO4:H2O2:H2O)

Warnings and Notes

- This procedure is for solutions that contain large amounts of water, used for etching purposes.
- All mixing ratios of the solutions you would like to make and use must be pre-approved by UDNF management in writing.
- Citric:H3PO4:H2O2:H2O is a corrosive (it can burn your flesh, eyes, lungs, and mucous membranes) and oxidizing (it can set things on fire) liquid.
- It contains Citric Acid, Phosphoric Acid (H3PO4), Hydrogen Peroxide (H2O2), and **large amounts of de-ionized water**.
- You must read the safety data sheets of its ingredients before you make and use the solution; the SDSs are available in the yellow binders located in the cleanroom, on the UNDF-Tools shared drive, and in the "User Resources" section of the website (udnf.udel.edu).
- Citric:H3PO4:H2O2:H2O may only be used in the organic acid wet bench in Bay 1 of the UDNF cleanroom.
- The Citric:H3PO4:H2O2:H2O must be used immediately after making it.
- You must have a safety buddy to use Citric:H3PO4:H2O2:H2O. The safety buddy does not have to stand by you nor wear the PPE listed in the next section. However, the safety buddy: (1) must be present in the cleanroom at all times while you use Citric:H3PO4:H2O2:H2O and while you clean up and (2) must check on you at least every 10 minutes.
- You must log into the "Chem_Citric-H3PO4-H2O2-H2O" tool in FOM before you start work and log out once you are done using the chemical. You must make reservations in advance in FOM.
- Identify the closest eye wash and safety shower before you start work.
- You must report all chemical spills and exposures to UDNF staff.

- Citric:H₃PO₄:H₂O₂:H₂O may be used only during staffed hours (typically 08:30-17:00, M-F while the University is open). Unstaffed hours will be announced via email and will be posted on the UNDF Calendar in FOM.
- You should expect to find the working area clean and dry and are required to leave the working area clean and dry. Please ask for staff assistance as needed.

Emergency Procedures

- In case of **skin contact**: Flush the affected area(s) while removing all contaminated clothing with large amounts of water for at least 15 minutes. Seek immediate medical attention.
- In case of **eye contact**: Flush the affected eye(s) with large amounts of water for at least 15 minutes. Seek immediate medical attention.
- In case of **inhalation**: Remove the exposed person to fresh air – only if it is safe to do so. Seek medical attention for symptoms such as respiratory irritation, cough, or tightness of chest; please keep in mind that symptoms may be delayed.

Personal Protective Equipment and Tools

- In addition to the normal UNDF cleanroom suit, the following safety PPE must be worn when making and handling Citric:H₃PO₄:H₂O₂:H₂O:
 - Chemical apron
 - Face shield
 - Heavy duty chemical resistant gloves
- The PPE must be inspected before you start any work:
 - If the chemical resistant gloves have any cracks, tears, holes, etc. please do not use them; ask staff for a new pair of gloves.
 - If the apron is not completely dry, please do not use it; please notify staff.
- Only use plastic tweezers or the blue locking forceps when working with Citric:H₃PO₄:H₂O₂:H₂O.

Use Procedure

- Identify your safety buddy.
- Inspect PPE; if anything is not right with the PPE, please **STOP** and notify UDNF staff.
- Log into “Chem_Citric-H3PO4-H2O2-H2O” tool in FOM. Enter the name of your safety buddy in the “Comment” section on the pop up window.
- Bring the following items into the wet bench:
 - Graduated cylinder
 - Eppendorf pipette and pipette tips
 - Two small beakers
 - Beaker to mix the solution in
 - Beaker to rinse your sample(s) in
- All beakers containing Citric:H3PO4:H2O2:H2O or its ingredients must be placed in the white secondary containment tray located in the wet bench.
- Use one of the pre-formatted labels available in the file folder in Bay 1 to write the name of the chemicals that are part of the solution and their mixing ratios, date and time, your name, and contact info. Place the note under the clean, dry beaker that will contain Citric:H3PO4:H2O2:H2O.
- Bring a number of cleanroom wipers into the wet bench and separate them; you will need them to dry the chemically resistant gloves if they get wet and to clean up when you are done using the chemicals.
- Attach your sample(s) to blue locking forceps and bring them into the wet bench.
- Put on the additional PPE in the following order:
 - Apron
 - Face shield
 - Chemical resistant gloves
- Fill a beaker with DI water for rinsing your sample(s).
- Move the bottles with fresh chemicals (one at a time, please follow the sequence outlined below) from the acid cabinet into the wet bench. Use both hands to carry the bottles.

- Make the Citric:H₃PO₄:H₂O₂:H₂O solution by adding its ingredients into the dry beaker in the following order (extremely important):
 - DI Water (measure the amount needed with a graduated cylinder).
 - Citric Acid (measure the amount needed with a graduated cylinder).
 - Phosphoric Acid (pour a small amount of chemical into a small beaker and use an Eppendorf pipette to dispense the amount needed; dispose of the pipette tip into the green container located in the wet bench; set the small beaker aside).
 - Hydrogen Peroxide (pour a small amount of chemical into a small beaker and use an Eppendorf pipette to dispense the amount needed; dispose of the pipette tip into the green container located in the wet bench; set the small beaker aside).
- Place the bottles with the fresh chemicals (one at a time) into the chemical cabinet located in front of the wet benches. Use both hands to carry the bottles.
- Place the sample into the beaker containing freshly made solution.
- Start the timer.
- Remove the sample from the Citric:H₃PO₄:H₂O₂:H₂O beaker and place it into the DI water beaker for rinsing.
- Dry the sample with nitrogen.

Waste Disposal

- Very slowly pour the contents of the small beaker containing Hydrogen Peroxide into the beaker of mixed solution. Rinse the small beaker with water over the sink.
- Very slowly pour the contents of the small beaker containing Phosphoric Acid into the beaker of mixed solution. Rinse the small beaker with water over the sink.
- Allow the Citric:H₃PO₄:H₂O₂:H₂O solution to cool to room temperature; use the thermometer located in the white tray. **Hot solutions will melt the plastic waste bottle** causing a chemical spill – they can also cause an explosion.

- Once the solution has cooled down, remove the cap of the waste bottle.
- Rinse the funnel with water over the sink.
- Very slowly pour Citric:H₃PO₄:H₂O₂:H₂O into the appropriate waste bottle using the funnel; do not overfill.
- **Note:** If you start a new waste bottle make sure it is dry on the inside and outside.
- Place the cap on the waste bottle.
- Rinse the funnel with water over the sink.

Cleanup and Final Steps

- Remove the label and dispose of it into the white “acid” trash can located in front of the wet bench.
- Wash all beakers and graduated cylinders with DI water three times over the sink.
- Place the beakers and graduated cylinders in the designated location.
- Wipe off any liquids from the bench, and dispose of the wipers into the white trash can located in front of the wet bench.
- While still wearing them, wash the chemical resistant gloves with DI water over the sink.
- Dry the chemical resistant gloves with wipers, and dispose of the wipers into the white “acid” trash can located in front of the wet bench. Pay attention to the under the forearm areas of the gloves.
- Wipe off any liquids from the apron, and dispose of the wipers into the white trash can located in front of the wet bench.
- Dry the chemical resistant gloves with wipers, and dispose of the wipers into the white “acid” trash can located in front of the wet bench. Pay attention to the under the forearm areas of the gloves.
- Remove PPE in the following order:
 - Remove gloves and place them in the wet bench.
 - Remove face shield.
 - Remove apron.
- Log out of “Chem_Citric-H₃PO₄-H₂O₂-H₂O” tool in FOM.