1 Objective:

This Standard Operation Procedure states how properly Piranha etching should be done with proper Personal Protection Equipment (PPE).

2 Responsibilities:

2.1 Director / HOD / PI

The Director/HOD/PI has overall responsibility for ensuring a chemical process is designed for the safe to treat the waste.

2.2 Designated Person

There shall be a designated person to oversee the correct procedures of treating the waste.

2.3 Staff/ Research personnel

a. Users shall attend appropriate training on the safe use of the Piranha chemicals.
b. Users shall report any injuries, defects or breakdowns to their supervisor.

3 Personal Protection Equipment

The handling of Piranha solutions requires special protection equipment including: **a full face shield**, **rubber lab-coat, and heavy duty rubber gloves** (regular Nitrile gloves will not provide sufficient protection). As a reminder, open-toed shoes are not allowed when working in the lab and bare legs must be covered by wearing a full size lab-coat.

4 Procedures

4.1. Prepare piranha solution

Clean out the fume hood completely.

Only use glass containers (preferably Pyrex) to handle Piranha. Piranha can melt and even attack plastic containers. Containers used during the experiment must be very clearly labeled and a warning sign, visible by any user working under the flow hood, must be posted at all time to indicate that the solutions contains Piranha mixture.

The standard piranha solution is a 3:1 (Volume) mixture of concentrated (≥95%) sulfuric acid (H_2SO_4) with 34% hydrogen peroxide (H_2O_2). When preparing the piranha solution, always add the peroxide to the acid very slowly**.** The H_2O_2 is added immediately before the etching process because it quickly produces an exothermic reaction with gas release. If

the H_2O_2 concentration is at 50% or greater, an explosion could occur. Mix the solution in the fume hood with the slash between you and the solution.

Piranha solution is potentially explosive. It is likely to become hot, more than 100°C. Handle with care!

4.2. Etch substrates

Dry the substrate before piranha etching. Place substrates in the piranha bath in one of the dedicated sample holders.

Leave the substrates in the piranha solution for 2 to 3 hours. Post a warning sign which is visible by any user working in the hot chemical room.

4.3. Collect substrates

Take the sample holder out of the piranha bath with care. Put the holder in a water bath to rinse it.

4.4. Piranha waste disposal

Never store hot piranha solution in an air tight container. The gas generated from the solution will cause over pressurization of the container, which will lead to an explosion. Therefore, prior to storage of the piranha solution it must be left in an open container in order to cool down below 30C. It is your responsibility to make sure that the open container is very clearly labeled and left in the fume hood to cool down.

Once cooled down, the solution should be diluted with water (with a ratio of 1:4)
NOTE add the acid slowly to the water!
Let this solution cool down for another half an hour before transferring into a glass container for waste storage. The container must be closed after sufficient cool down. The container must be very clearly labeled with the solution name and composition and must include **VISIBLE** warning signs not to add any other types of chemicals. Store the container in a safe waste tray.

5 References:

http://www.enma.umd.edu/LAMP/Sop/Piranha_SOP.htm

6 Emergency procedure

In case of large exposure, the victim should be removed from the contaminated area, placed under a safety shower while emergency personal is contacted (999)

All contaminated clothing should be removed immediately with appropriate gloves and safely discarded.

In case of contact with the skin, May cause skin burns. The affected area must be immediately rinsed with large amounts of water for at least 15 min.

In case of contact with the eye, irrigate the eye for at least 30 minutes, keeping the eyelids apart and away from eyeballs during irrigation. Place ice pack on eyes until reaching emergency room.

In case of inhalation, it may irritate the respiratory tract. Conscious persons should be assisted to an area with fresh, uncontaminated air. Seek medical attention in the event of respiratory irritation, cough, or tightness in the chest. Symptoms may be delayed.