Cleaning Procedures

EC-MS Technical Note #12

last updated 30-08-2022

This technical note aims to equip Spectro Inlet's EC-MS users, and indeed anybody doing fundamental electrochemical studies, with an overview of appropriate cleaning procedures for various experimental applications.
We would like to stress that "best practices" in terms of choosing the correct cleaning procedure depends strongly on the type of experiment being conducted [1], what level of cleanliness is required and to what extend the user are able to control the sample composition/uniformity [2]. Considering these aspects, several cleaning methods are outlined, including their benefits and downsides as well as hazards and user requirements.
Cleaning electrochemical systems is an often overlooked aspect within electrocatalysis. However, just as standardized sample preparation, *e.g.* using the *Clavilier* method for Pt electrode investigations [3], standardizing the cell condition can be of equivalent importance. Especially, when conducting model studies; a field at which the EC-MS system excel (for general notes on electrode preparation see [2]). While some control of cleanliness is of obvious importance [4, 5], the cleanliness required for specific EC-MS applications may vary. The methods mentioned herein are therefore suggestions and NOT requirements, *i.e.* any cleaning procedure should be chosen to match the users needs and (cap)abilities.
When initially receiving the EC-MS system it arrives with at PCTFE EC-MS cell, chips, U-cups, luer- and Luggin adapters among others, see figure 1 for an overview.

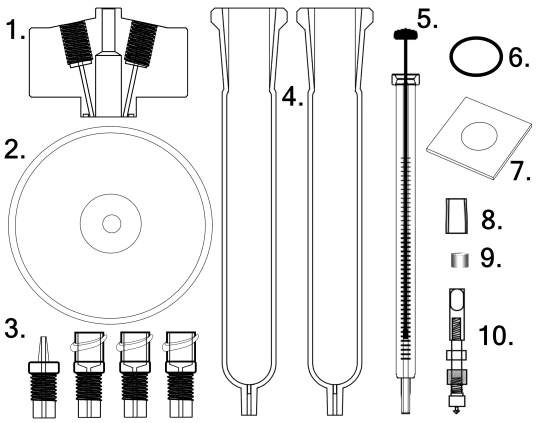


Figure 1: EC-MS items relevant for cleaning: **1.** EC-Cell **2.** Mounting block. **3.** Luer adapters. **4.** Luggin adapters. **5.** Hamilton syringe. **6.** Kalrez® O-ring. **7.** Chip. **8.** U-cup. **9.** Sample. **10.** U-cup assembly.

Spectro Inlet recommend EC-MS users to purchase appropriate syringes or alternative systems for electrolyte injection. Moreover, it is recommended to acquire a polycrystalline platinum (Pt_{Poly}) or glassy carbon (GC) electrode sample to benchmark the EC-MS system prior intended use, see ***Benchmark Measurements EC-MS Technical Note #2***.
While the specific GC or Pt_{Poly} sample electrodes may have little relevance to the user, their response in the EC-MS system are well suited to: *i*) Benchmark the received EC-MS system *ii*) Train new EC-MS users. Consequently, in the following we will list typical cleaning procedures for first time EC-MS use, aimed towards enabling standard aqueous EC-MS benchmarking experiments described in the ***Benchmark Measurements EC-MS Technical Note #2***, while in the second part general cleaning procedures will be discussed.

Cleaning procedure for first time users

As a first time user to the EC-MS (and perhaps even to electrochemistry) one should rightly ask oneself: *"How clean does my system need to be, what needs to be cleaned and how do I clean it ?"* While all of these questions are more or less application dependent as a general rule users should:

1. Only clean parts in contact with the electrolyte or sample.
2. Only clean to an extend matching the electrolyte- and sample purity.
3. Always assume electrolyte on the opposite of the Luggin adapters (from the EC-cell) is impure

The latter point may nor seem straightforward, but essentially this implies that extensive cleaning of the insides of the Luggins are not recommended as these are likely to be compromised by either the chosen reference- or counter electrode, as indicated by figure 2.

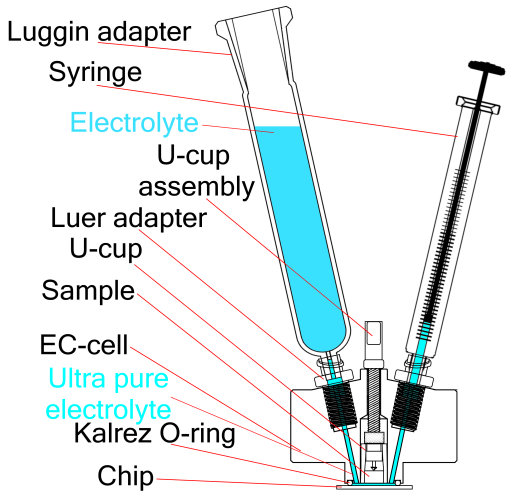


Figure 2: Items in contact with electrolyte in the EC-MS cell. Note, while the U-cup assembly is not in contact with the electrolyte (and never should be) U-cup failure may result in electrolyte seeping onto the electrode backside giving rise to contamination, added capacitance's and O_2/N_2 penetration into the cell.

To enable users to quickly reproduce the results matching those reported in the ***Benchmark Measurements EC-MS Technical Note #2*** we highlight two cleaning examples for GC and Pt_{Poly} electrodes, respectively. It is important to stress that the benchmark experiments are NOT designed for getting fundamental insights of the samples' electrocatalytic properties, but rather show expected EC-MS system performance as with respect to the sample type.

Cleaning for GC benchmarking

For this type of experiments a GC electrode ($\varnothing \times h = 5 \times 4$ mm) is investigated, see ***Benchmark Measurements EC-MS Technical Note #2***.[1]
As for any EC-MS experiment the cleaning level will never exceed the sample purity, *i.e.* for GC samples we recommend the user polishes the GC electrode before its first use. Different procedures exist but generally hand polishing with alumina powders in coarseness ranging from 3 to 0.05 μm are sufficient to form the desired mirror-like polish and remove any trace-metal residue from the GC surface. Trace alumina from polishing can be removed by repeated rinsing and sonication in ultra pure water, see section **Sonication in water**.
We recommend the following first time cleaning procedure for conducting GC benchmarking (as described in ***Benchmark Measurements EC-MS Technical Note #2***):

1. Ensure you have all the following items: (**Item 1**) PCTFE EC-cell, (**Items 2-9**) PCTFE mounting block, $4\times$ Luer adapters, $2\times$ Luggin adapters, glass syringe, Kalrez® $\varnothing \times W = 10 \times 1$ mm O-ring, chip, U-cup, GC electrode. (**Item 10**) U-cup assembly. (**Item 11**) $2\times$100 mL glass beakers with matching watch glass lids. (**Item 13**) Clean tweezers. (**Item 14**) Aluminum foil. (**Item 15**) Tray. (**Item 16**) $\sim$ 250 mL fresh Piranha solution (3:1 H_2SO_4(96%):H_2O_2(30%)). Warning: Piranha mixing is a violently exothermic and forms a highly oxidizing and corrosive solution, hence local Health & Safety measures must be followed! (**Item 17**) Ultra-pure water source (*e.g.* a Millipore® Milli-Q system). (**Item 18**) Fume hood. (**Item 19**) Crystallization bowl. (**Item 20**) Hot plate. (**Item 21**) Lab oven (optional).

2. Prepare the parts to be cleaned: Rinse the parts which are to be in contact with electrolyte (**Items 1-9**) and the two 100 mL beakers and watch glass lids (**Item 11**) in ultra-pure water (**Item 17**). Separate the glass syringe (**Item 5**) from its plunger.

3. Piranha clean the parts: Place the parts (**Item 1-9**, without the syringe plunger as this is not resistant to Piranha) in the two 100 mL beakers. Place these beakers in the tray (**Item 16**) in a fume hood (**Item 18**) and carefully pour fresh Piranha into the beakers immersing the parts. Note, the Luggin adapters does not have to be cleaned, but it can be practical to do so. Once the parts are soaking, cover the beakers with the watch glass and keep like this for $\sim$ 24 h. After this, pour Piranha back into original container for storage or later disposal Warning: Never seal containers containing Piranha! Rinse beakers *ca.*$3\times$ with ultra-pure water (**Item 16**) using the watch glass as safeguards not to drop any of the now cleaned parts dirtying them.

[1] GC electrodes are available from many vendors or can be manufactured, we recommend high purity carbon material such as Sigradur G® from HTW-GmbH or electrodes available directly from Pine Instruments.

4. Desorb residual sulphates and organics by rinsing while heating: Place the two beakers with cleaned materials into the crystallization bowl (**Item 19**). Fill bowl so the water level reaches halfway up the beakers. Place the rinsed plunger (rinsed in Mill-Q) from the syringe with the beaker of the mounting block. Now place the crystallization bowl on a hotplate (**Item 20**) and start heating to between 70 -90 °C for at least 15 min. Once heated, exchange the water in the beaker with ultra-pure water (**Item 17**), repeat this 15 min heating-rinsing sequence *ca.* $3\times$. Warning: Do not allow the water in the crystallization bowl to boil and/or dry out, and remember to turn off hotplate after use.

5. The pre-mounted chip can now be dismounted from the mounting block (see ***EC-MS Manual v1.15***) and cleaned by repeated boiling and rinsing in Milli-Q water, see section **Heating combined with rinsing with water**.

6. Store the cleaned parts until use: After the final rinse remove beakers from hotplate and cover with fresh aluminum foil (**Item 19**). Care should be taken not to touch any part of the foil adjacent to the water interface. Materials can be stored 1-2 days only requiring minimum additional rinsing before use. The chip, if cleaned, needs to be dried first using pressurized air and then using a lab oven (**Item 21**) 1 h at 70 °C before remounting onto the EC-MS interface block, see ***EC-MS manual v1.15***.

7. Assemble EC-cell: Empty the beakers and dry all the elements *e.g.* using pressurized air (particle and oil free) or even high purity gas. To handle the elements use a clean pair of tweezers (**Item 13**) and fresh alumina foil (**Item 14**). Follow the assembly procedure provided in the ***EC-MS manual v1.15*** and take care not to touch any part of the system directly in contact with electrolyte. Tip: Having cleaned two beakers allows for one of the now spare beakers be used for mixing fresh electrolyte. For proper assembly see ***Avoiding MS-Signal Fluctuations Caused by Bubbles EC-MS Technical Note #11***.

8. Verify cleanliness using the GC experiment: GC benchmarking experiment should exhibit only minute degree of hydrogen evolution at potentials above $-0.5\,V_{RHE}$ in 0.1 M $HClO_4$, *e.g.* mixed using 70 % Sigma-Aldrich's Ultrapur® $HClO_4$ and Milli-Q water (18.2 MΩcm, TOC< 10 ppm). Note, keeping the GC electrode at cathodic potentials (*e.g.* $< 0.0\,V_{RHE}$) for extended time allows adsorption of trace-metal impurities. These are typically more active towards the hydrogen evolution reaction (HER) and the effect of this should be observable in the benchmarking experiments. Note, it is impossible to completely exclude any unwanted ad atoms by cleaning alone and hence the benchmarking should only be seen as a crude gauge to see if sufficiently low HER onset potentials can be achieved with a GC electrode.

9. After experiments the electrode and EC cell should be disassembled and rinsed in ultra-pure water before being dried with clean pressurized air. Cell can be kept either dry packed in fresh aluminum foil (**Item 14**) or kept in clean glass beakers completely immersed in ultra-pure water and protected with aluminum foil covering the beaker. If the cleaned EC-MS system are to be used in future non-aqueous investigation, keeping the clean cell and components in a dry lab oven (**Item 21**) may be preferable.

Following the preceding steps allows users to get sufficiently clean working conditions to observe the GC electrodes' inherent HER and CO_2 evolution potential, as GC will evolve CO_2 rather than oxygen - from the oxygen evolution reaction (OER)- at sufficiently cathodic potentials (< 1.23 V).

Cleaning for Pt_{Poly} benchmarking

In contrast to the GC benchmarking procedure, the cleaning level required to conduct the benchmarking measurement on Pt_{Poly} is rather low. The reasons being that 1) Pt_{Poly} is an excellent HER catalyst 2) with a distinct oxidation potential. The suggested procedure for sufficiently cleaning the as-received EC-MS cell and associated parts enabling reproduction of the Pt_{Poly} benchmarking, as described in ***Benchmark Measurements EC-MS Technical Note #2***, goes as follows:

1. Ensure you have all the following items: (**Item 1**) PCTFE EC-cell, (**Items 2-9**) PCTFE mounting block, $4\times$ Luer adapters, glass syringe, $2\times$ Luggin adapters, Kalrez® $\varnothing \times W = 10 \times 1$ mm O-ring, U-cup, Pt_{Poly} electrode. (**Item 10**) U-cup assembly. (**Item 11**) Clean $\sim$ 250 mL glass beakers with glass cover. (**Item 13**) Clean tweezers. (**Item 14**) Aluminum foil. (**Item 15**) Ultra-pure water source (*e.g.* a Millipore® Milli-Q system). (**Item 16**) Crystallization bowl. (**Item 17**) Hot plate. (**Item 18**) Lab oven (optional).

2. Procedure: Fill the beaker (**Item 11**) with all the parts needing to be cleaned *i.e.* mounting block, syringe (separated into syringe and plunger) and parts to be in direct contact with electrolyte (**Items 2-9**). Note, the Pt electrode should ideally be prepared following established protocols *e.g.* using the *Clavilier* method [3]. The beaker is filled with ultra-pure water and covered with watch glass as lids (**Item 11**). The beaker is then placed in a crystallization bowl (**Item 16**) with water and placed on a hot plate (**Item 17**). The water is heated to between 70 -90 °C for at least 15 min. Once heated, exchange the water in the beaker with ultra-pure water (**Item 15**), repeat this 15 min heating-rinsing sequence *ca.* $3\times$ times. Warning: Do not allow the water in the crystallization bowl to boil and/or dry out and remember to turn off hotplate after use.

3. Dismount the pre-mounted chip from the mounting block (see ***EC-MS Manual v1.15***) and clean it by repeated heating and rinsing in Milli-Q water, see section **Heating combined with rinsing with water**.

4. Drain the now cleaned parts for water and dry in a clean air stream. If chip has been rinsed drying in a oven at 70 °C for 1 h is recommended. Using the tweezers (**Item 13**) and/or aluminum foil (**Item 14**) the EC-MS-cell can be assembled following the guidelines in ***Avoiding MS-Signal Fluctuations Caused by Bubbles EC-MS Technical Note #11***.

5. Verify cleanliness using the Pt_{Poly} benchmarking experiment: Pt_{Poly} should exhibit significant HER at potentials near 0.0 V_{RHE} in 0.1 M $HClO_4$, *e.g.* mixed using 70 % Sigma-Aldrich's Ultrapur® $HClO_4$ and Milli-Q water (18.2 MΩcm, TOC$<$ 10 ppm). Note, the Pt_{Poly} electrode should exhibit clear hydrogen under potential deposition/desorption

features and OH adsorption and desorption (redox pairs) when cycling from 0 to 1 V_{RHE}. Cycling to potentials above 1.2 V_{RHE} will certainly reconstruct/dissolve some of the Pt surface, and cycling below 0 V_{RHE} tend to generate too much hydrogen bubble formation destroying electrode contact. Unexpected features in the double-layer region the CV could suggest poisoning of the cell/electrode, or if negative double layer current is observed likely an air leak exist as oxygen reduction reaction (ORR) could account for this type of current response.

6. After experiments the electrode and EC-cell should be disassembled and rinsed in ultra-pure water before being dried with pressurized air. The cell can be either be kept in a clean beaker in Milli-Q water and covered fresh aluminum foil (**Item 18**) or kept dry packed in fresh aluminum foil or in a dry lab oven (if concerns over water content has relevance for future EC-MS investigations).

The cleaning procedures sketched out in the above, enabling for GC and Pt_{Poly} benchmarking EC-MS measurements, are while functional **NOT** to be considered absolute. Cleaning can be done to any level the user is comfortable with for their specific needs and for additional tools which cleanliness is believed relevant. Cleaning procedures used within electrochemistry are many, but to get a overview of some common procedures and their applicability to the EC-MS systems we recommend users to either confer with the following sections.

Additional cleaning procedures and when to use them

This section covers various cleaning procedures, when to use them, benefits and hazards.

Cleaning with water

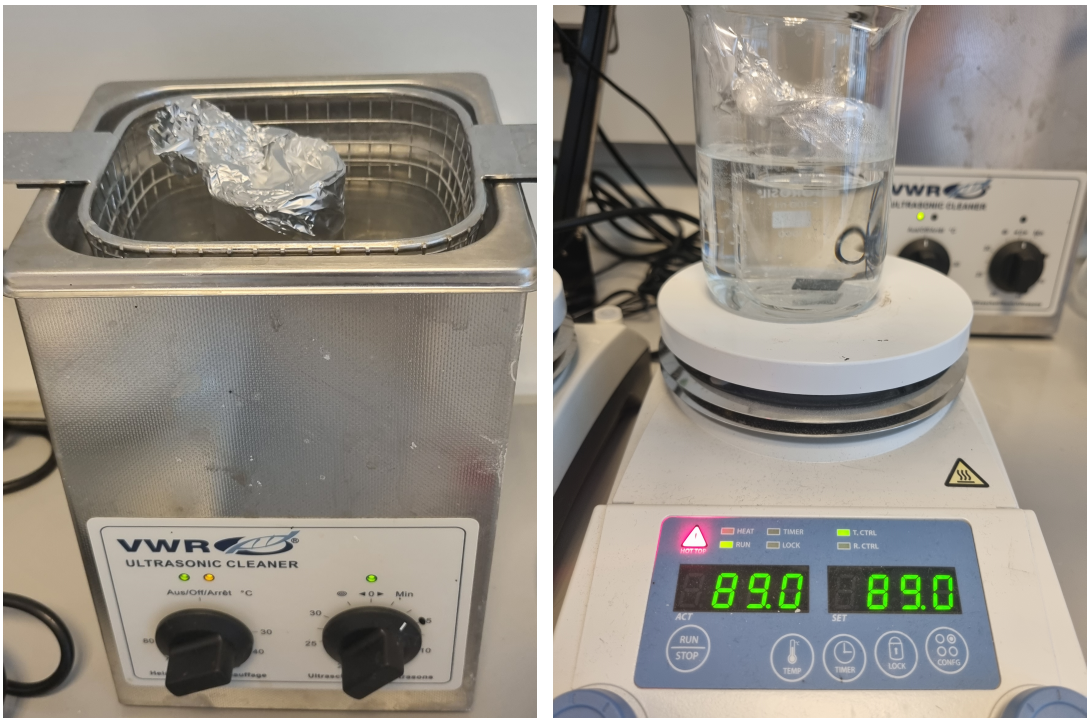
All the parts in figure 1 can be rinsed in water, except the U-cup assembly. However, tap and even DI water is typically not pure enough for reliable electrochemical investigations. Hence, we always recommend using an ultra-pure water source such as Milli-Q water (18.2 MΩcm, TOC< 10 ppm). It should also be noted that for any cleaning procedure regardless if its of glassware, chips or EC-MS cell parts are typically followed by rinsing with clean water.
When rinsing in water, some water may enter the chip volume. We found that drying them in a clean lab oven at 70 °C for 1 h works drying the chips, see figure 3.
Cleaning with water can be done in many ways, in the following general "rinsing", "heating and rinsing" and "combined rinsing and sonication" procedures will be presented.



Figure 3: Chip drying in a lab oven.

Rinsing

Compatibility: All items in figure 1 except the U-cup assembly.
When to use: Whenever parts have been standing idly by, when initially received or when knowingly or visibly have become dirty.
Pros: Non-toxic and safe cleaning method requiring only an ultra-pure water source and sufficiently clean receptacles for the handling. Can be repeated for any number of times user finds it needed. Easy disposal and compatible with most materials.
Cons: As a stand-alone not capable/poor at removing contaminants originating from solvents, fats, metal and/or oxide traces.
Hazards: None



(a) (b)

Figure 4: Disassembled EC-Cell with chip in a clean beaker. **(a)** Being sonicated at 80 °C and rinsed in Milli-Q water. **(b)** Being heated to 89 °C and rinsed. Note, herein this example heating takes place inside another beaker instead of a crystallization bowl.

Heating combined with rinsing with water

Compatibility: All items in figure 1 except the U-cup assembly, see figure 4a.
When to use: Whenever parts have been standing idly by, when initially received or when knowingly or visibly have become dirty.
Pros: Non-toxic cleaning method requiring only a ultra-pure water source, hot plate, crystallization bowl and sufficiently clean receptacles for the handling. Can be repeated for any number of times user finds it needed. Easy disposal and compatible with most materials.

Cons: As a stand-alone not capable/poor at removing contaminants originating from some fats, metal and/or oxide traces.
Hazards: Never boil as: 1) Convection may actually introduce additional contaminants over time. 2) Boiling narrow necked glass objects can "shock boil", this also generally tend to happen in clean (low nucleation-site) containers. 3) Most fats and solvent desorb and thus allow for flushing from equipment by repeated rinsing at temperatures around 70-90°C *i.e.* its not beneficial to raise the temperature further. Always use a crystallization bowl with water as for placing beakers with components inside to be cleaned as this will guarantee even heat distribution and avoid cracked glass, spills of heated water, and extent the hot plate's lifetime. Hot plates comes with build-in hazards for burns and fire if irresponsibly operated.

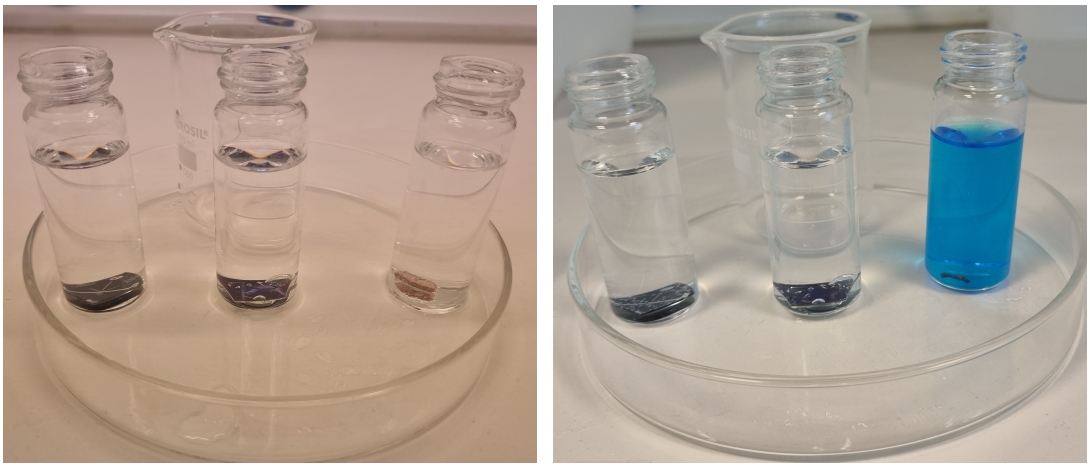
Sonication in water

Sonication is usually done in ultra-pure water, but can also be done using certain solvents, in which case fume hood access is imperative. Sonication allows contaminants to detach and transfer to the surface.
Compatibility: Most parts of figure 1, as well as other auxiliary Teflon or glass pieces, but **NOT** not materials containing porous frit materials (*i.e.* ceramics or other exceedingly brittle materials). Warning: Do not sonicate U-cup assembly, Luggin adapters or non-aqueous chips as these are damaged. Extended sonication has not shown any effect on standard chips. Never seal containers with solvents when sonicating as evaporation may cause pressurization of the container.
When to use: Whenever parts have been standing idly by, when initially received or when knowingly or visibly have become dirty, after sample polishing, *aqua regia*- or Piranha cleaning.
Pros: Non-toxic cleaning method requiring only a sonicator, ultra-pure water source or other cleaning solvent, sufficiently clean receptacles for the handling. Can be repeated for any number of times. Easy disposal and compatible with most materials except mechanically frail and brittle materials. Can with benefit be combined with heating making cleaning more effective.
Cons: As a stand-alone not capable/poor at removing contaminants originating from fats (when using water) and trace-metal/oxides.
Hazards: If used with organic solvents vapor development can be hazardous. Prolonged exposure to sonication can have detrimental hearing effects, see local Health & Safety measures and product guidance for safe use of sonication equipment and consider placing sonicators in hereto suited sound-proof box. Only use sonicators at prescribed water levels as the shortening of the system lifetime and even fire risk is associated with "dry running" sonicator equipment.

Cleaning in dilute nitric acid

Dilute nitric acid is a less hazardous alternative to cleaning in *aqua regia* or Pirnaha capable of oxidizing/dissolve most trace metal impurities and even some organics. Herein, we have

used ultra-pure water and mixed in ~15% nitric acid (use analytic grade or higher).
Compatibility: All Teflon and glass parts *i.e.* those of figure 1 expect the U-cup assembly and syringe plunger. Standard aqueous and non-aqueous chips alike appear compatible with this type of cleaning.
When to use: For cleaning plastics and even certain metal types. Typically used when what is wanted cleaned is not "too" dirty and incompatible with Piranha or *aqua regia e.g.* plastic pipettes, pipette tips *etc.*
Pros: Relative good alternative to strong oxidizers. Enables reasonably cleaning of plastic pipettes, EC-MS standard chips *etc.*
Cons: Generally not that effective at dissolving metal traces and requires cumbersome chemical disposal. Demands extensive post rinsing and/or sonication (with heating).
Hazards: Mixing water and nitric acid requires good safety practices and basic chemical/laboratory knowledge. Concentrated nitric acid represent its own hazards that user should be acquainted with prior to its use. **NEVER** risk mixing with organic solvents! Generally, follow local Health & Safety measures and familiarize yourself with relevant handling- and regulatory procedures.



(a) (b)

Figure 5: Aqueous chip (left) non-aqueous chip (center) and piece of Cu (right) placed in 15% diluted nitric acid (37%) and Milli-Q water. **(a)** Initial. **(b)** After 24 h. NB the significant color change is due to Cu dissolution on the sample to the right.

Cleaning in Piranha

Piranha consists volumetric of 3:1 H_2SO_4(95%):H_2O_2(30%) (use analytical grade or higher) and is exceptionally reactive, corrosive, oxidizing and exothermic when mixed, see figure 6a. Cleaning procedure in Piranha requires both preparation and knowledge and we urge all users contemplating utilizing Piranha to consider safer alternatives. If not possible we advise users to exercise extreme caution.
Compatibility: All Teflon and glass parts of figure 1 except the U-cup assembly and syringe plunger. Also, GC electrodes and Pt electrodes and chip can be cleaned, albeit total immersion times should be kept short. Most ceramic frit materials can handle limited cleaning

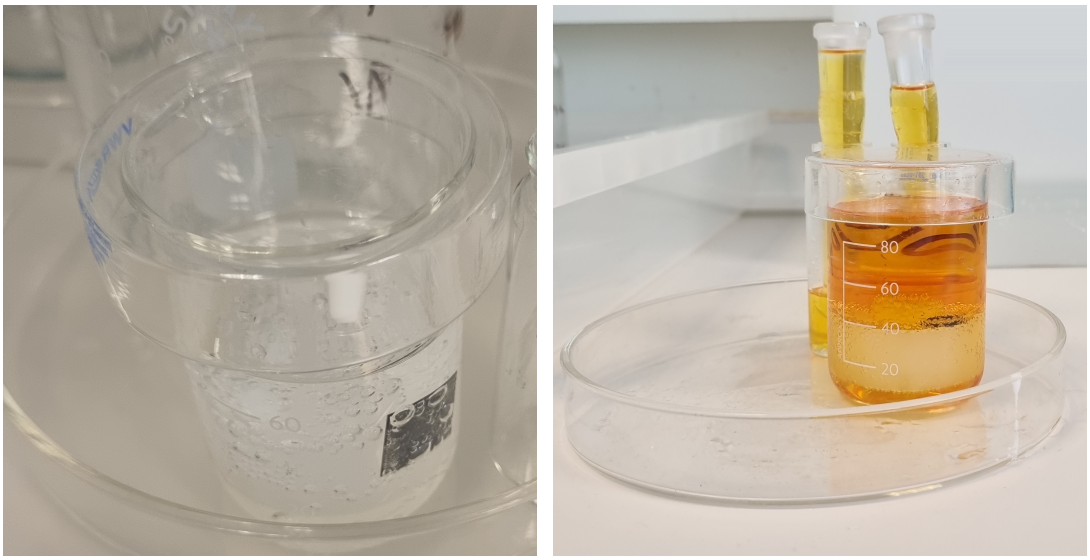
in Piranha. However, over time glass-ceramic connections tend to break down destroying the glass-ceramic integrity *i.e.* the Luggin adaptors provided with the EC-MS system can degrade over time. Similarly, the standard chips may wear out faster if regularly exposed to Piranha, although this has not been sufficiently tested or even observed. Warning: We do not recommend cleaning of non-aqueous chips in Piranha.

When to use: Whenever parts have been standing idly by, when initially received or when knowingly or visibly have become dirty and specifically when high cleanliness fundamental model studies are attempted with the EC-MS system. Usually also employed for cleaning all glassware for electrolyte and ultra-pure water containers.

Pros: Extremely effective at removing organics, most noble trace-metals and oxides.

Cons: Requires subsequent water rinsing combined with heating for sufficient cleanliness. Mixing, handling and disposal of Piranha requires extensive training, an acid resistant fume hood and appropriate personal protective equipment.

Hazards: Significant dangers arise when mixing as the violent exothermic reaction can cause "shock boiling" and spillage and glass breakage if non-optimal materials are used. Handling is notoriously cumbersome and should only be done within the confines of a designated fume hood. Disposal is elaborate and requires extensive dilution prior neutralization or direct disposal as dangerous chemical waste. Having Piranha in closed and/or narrow necked containers is associated with extreme dangers due to gas evolution and rapid gas expansion when boiling. **NEVER** store in fume hoods or cupboards with any type of organic solvents! Generally, follow local Health & Safety measures and familiarize yourself with relevant handling- and regulatory procedures.



(a) (b)

Figure 6: Example of disassembled EC-cell parts with chip in a clean beaker. **(a)** In fresh Piranha. **(b)** In fresh *aqua regia*.

Cleaning in *Aqua regia*

Aqua regia consists volumetric of 3:1 HCl(37 %):HNO_3(69 %) (use analytical grade or higher) and is exceptional reactive, corrosive, oxidizing and exothermic. The mix is especially useful within the first 24 h after mixing. Cleaning procedure, see figure 6b, using *aqua regia* requires both preparation and knowledge and we urge all users contemplating utilizing *aqua regia* to consider safer alternatives. If not possible we advise users to exercises extreme caution.

Compatibility: All Teflon and glass parts of figure 1 except: The U-cup assembly, non-aqueous chips and the syringe plunger. Note, some discoloration of PCTFE items is likely and certain for any PTFE items. This discolouration can widely be reversed in diluted peroxide and/or Piranha after having been rinsed post *aqua regia* cleaning. Similarly, as for Piranha, although as of yet not sufficiently tested, the standard chips may wear out faster if regularly exposing them to *aqua regia* and similarly we do not recommend cleaning of non-aqueous chips using this chemistry. Warning: *Aqua regia* will dissolve (Au, Pt, Pd, Ag, Os, *etc.*) and/or oxidize most electrode materials (such as GC). Most ceramic frit materials are able to handle limited cleaning in *aqua regia*. However, over time the glass-ceramic connections tend to break down destroying the integrity of the Luggin adaptors provided with the EC-MS system.

When to use: When specific trace metals needs to be completely excluded from the EC-MS experiments, *e.g.* Au, Pt RuO_x *etc.*

Pros: Extremely effective at removing organics, noble trace-metals and oxides.

Cons: Just as for Piranha *Aqua regia* cleaning requires subsequent water rinsing combined with heating to reach sufficient cleanliness. Mixing, handling and disposal of *aqua regia* requires extensive training and dictate the availability of an acid resistant fume hood and appropriate personal protective equipment.

Hazards: Significant dangers arise when mixing as the violent exothermic reaction can cause "shock boiling" and spillage and glass breakage if non-optimal materials are used. Handling is notoriously cumbersome and should only be done within the confines of a designated fume hood. Disposal is elaborate and requires extensive dilution, any attempt to neutralize solution may form toxic NO_x gases. A specific danger when pouring *aqua regia* in receptacles is the combination of aeration and filling of (often very) dirty containers can cause "shock boiling" (even in rather open containers). Any use of concentrated nitric acid and hydrochloric acid carries significant risk. **NEVER** store in fume hoods or cupboards with any type of organic solvents! Generally, follow local Health & Safety measures and familiarize yourself with relevant handling- and regulatory procedures.

Concluding remarks

This note provides Spectro Inlets' EC-MS users with a tool enabling high quality electrochemical experimentation under clean conditions.

For additional inquiry about best practices and questions regarding cleaning, assembly and maintenance of Spectro Inlets EC-MS product please confer with our online resources at

www.spectroinlets.com/resources/ or contact Spectro Inlets' EC-MS R&D department directly at support@spectroinlets.com with your specific question(s), application needs and/or relevant suggestions.

References

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