# SOP for Handling and Cleaning CVD Diamond

CVD diamond has a range of extreme properties, but some of these can only be used to advantage if the sample is clean and has the appropriate surface termination. CVD diamond will pick up grease and other organic dirt very easily during handling and requires rigorous cleaning to subsequently remove them.

## **Handling CVD Diamond**

* Never handle CVD diamond with bare fingers. Use clean gloves - vinyl or cotton gloves are suggested.
* Use tweezers, preferably ceramic. Ensure that the tweezers are clean.
* After cleaning, samples should be wrapped in a lint-free paper, such as vellin tissue.
* Many containers are capable of contaminating CVD diamond, particularly those with plastic films where the plasticisers can deposit on the diamond. Use glass bottles if available.

## **Cleaning CVD Diamond**

Diamond surfaces can either be insulating or conductive depending on their termination. Many electronic applications need an insulating surface and therefore require an oxygen-terminated surface. This is achieved through the cleaning process.

**1) Acid Clean**

CVD diamond can be cleaned using powerful oxidising agents. One of these uses hot, concentrated sulphuric acid with potassium nitrate. Alternative procedures in the literature use, for example, boiling concentrated chromic acid. Solvent cleaning with propanone or propan-1-ol does not fully remove grease and other dirt from diamond surfaces.

The procedure using sulphuric acid and potassium nitrate is described below.

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| **This procedure uses potentially dangerous chemicals, including acids. It should only be attempted by individuals who have received appropriate training and are fully competent in the use of these chemicals. In addition the procedure should only be undertaken in a fume-cupboard with appropriate personal protective equipment (eg. gloves, eye protection, apron) being worn.**  **Anyone using this procedure does so entirely at their own risk**. |

1. Place the CVD diamond sample in a Pyrex (or equivalent) beaker and add concentrated sulphuric acid to comfortably cover the sample.
2. Place the beaker on a hot plate and heat until the sulphuric acid is fuming (wispy white fumes are given off). At this point the temperature is in excess of 200°C.
3. Carefully, using a long handled spatula, add potassium nitrate (KNO3) to the hot acid with a ratio of ~5 g KNO3 to every 100 ml of sulphuric acid. The mixture will give off brown fumes and possibly spit during this operation. It is important not to add more than the recommended amount of potassium nitrate. The cleaning is affected by the decomposition of the nitrate to release oxygen. The solution should be maintained at temperature for approximately 10 minutes.
4. Allow the solution to cool.
5. Decant the acid from the sample and then rinse it several times using deionised water. Dispose of the acid appropriately.
6. Dry the CVD diamond sample using a dry-air duster.
7. Wrap in a lint-free paper and package appropriately.

**1) Ozone Clean**

The ozone apparatus is situated in a fume-cupboard in Wuge’s lab E017. Before using this for the first time, ensure that you have been trained by a competent person.

1. Ensure the machine is turned on from the plug. Open the drawer and place the samples in, diamond side facing up. Many samples can be placed in here at once. Make of note of which sample is which!
2. Shut the drawer and set the timer on to 20 mins, then press the start button. The machine will hum as air is pumped across the UV light.
3. After the set time the machine will shut off. Open the drawer and place the samples back into their containers.

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