

Surface Cleaning

Hydrogen Plasma Cleaning to remove contamination

World Leaders in Measurement and Accuracy

The National Physical Laboratory (NPL), is the UK's National Measurement Institute and is a world-leading centre of excellence in developing and applying the most accurate measurement standards, science and technology available.

For more than a century NPL has developed and maintained the nation's primary measurement standards.

These standards underpin the National Measurement System infrastructure of traceability throughout the UK and

the world that ensures accuracy and consistency of measurement. NPL ensures that cutting edge measurement science and technology have a positive impact in the real world. NPL delivers world-leading measurement solutions that are critical to commercial research and development, and support business success across the UK and the globe.

Henniker's Plasma Treatment equipment is being evaluated so it can be used in keeping the accuracy of the UK's measurement standards.

Alternative Solutions

The SI unit of mass is the kilogram and is defined as being equal in mass to the international prototype of the kilogram (IPK).

The IPK and other primary kilogram mass standards kept at National Measurement Institutes such as NPL consist of a cylinder of platinum-iridium alloy with diameter and height roughly 39 mm.

These require periodic cleaning to remove surface hydrocarbon contamination that deposits from the ambient environment.

The current cleaning method relies on

a solvent cleaning step followed by rinsing in a jet of steam.

As it is a manual process, the repeatability of the cleaning is dependent on the human operator and there is risk of damaging the standard by removing particles of platinum-iridium from the surface.

The Swiss National Measurement Institute pioneered the use of plasma cleaning for mass standards [1] Henniker were approached to help NPL set up a plasma cleaning facility as their equipment had been recommended by colleagues at the Swiss NMI.



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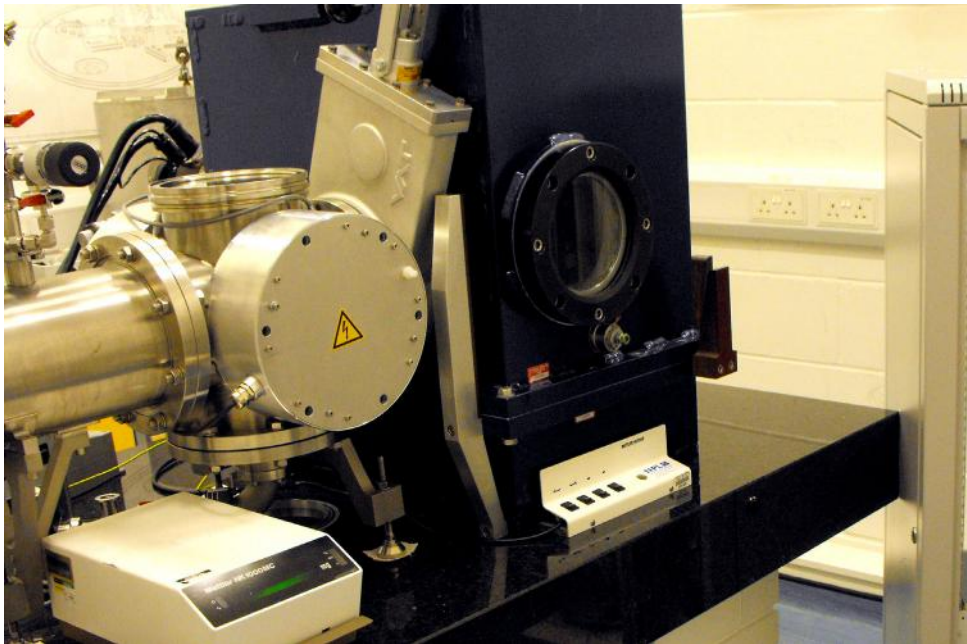
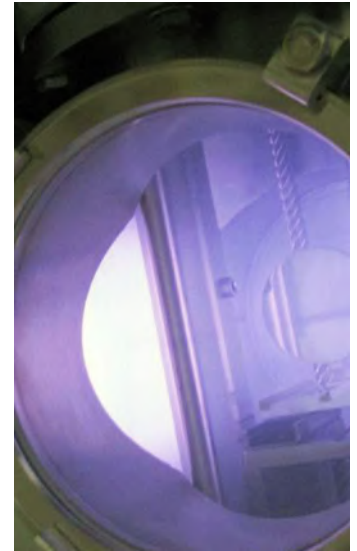
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Non-contact cleaning methods

The aim was to find an alternative non-contact method of cleaning primary mass standards that does not involve a manual abrasive process. Plasma Cleaning was identified as a potential cleaning method as it does not require physical contact to be made to the surface being cleaned.

The approach taken was to incorporate a hydrogen plasma cleaning facility within an existing bespoke vacuum chamber.

This vacuum chamber is connected to another vacuum chamber containing a precision mass balance and the advantage of this approach is that mass standards can be cleaned and weighed in vacuum without exposing them to ambient air where they would be at risk of potential exposure to airborne hydrocarbon contamination.



NPL's Plasma Cleaning Apparatus

Our Solution

Henniker supplied the primary plasma generation method for the NPL bespoke vacuum cleaning apparatus.

The 40kHz pulsed width modulated generator worked perfectly and successfully generated and sustained a hydrogen plasma at a pressure of 0.7 mbar.

Initial results from hydrogen plasma cleaning stainless steel standard masses demonstrated the effectiveness of this cleaning method.

In one cleaning trial approximately 60µg of contamination that had built up on the surface of a precision mass standard over a period of ten years was successfully removed using hydrogen plasma cleaning.

NPL now plans to perform additional trials on platinum-iridium test samples. If these trials prove successful then the cleaning method can be tested on primary platinum-iridium kilogram mass standards.


[1] P.Fuchs Applied Surface Science 256 (2009) 1382-1390

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*James Berry,
of NPL.*


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passionate about plasma®

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Case Study