



Plasma Cleaning

A new method to get ultra-clean cryostats

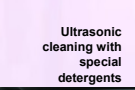
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Before Plasma Cleaning

Conventional cleaning should be applied:

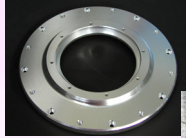


Detergents and chemical solvents for conventional cleaning



Ultrasonic cleaning with special detergents

Baking in a vacuum oven



Before Plasma cleaning

After conventional cleaning the parts look rather clean, but there are still (organic) contaminations on the surface.

Metal sample with organic contamination

Abstract:

First results are reported from the application of a plasma-based method to ultra-clean detector cryostats. The device used is a LFG40 Controller from Diener Electronic (<http://www.diener-electronic.de>) in connection with a Kendro VT6060M vacuum oven.

This technology considerably extends and enhances the cleaning methods used by ESO as described at SDW2002. It cannot replace them but actually requires their previous application. Its virtues are the speed and ease of application. Particularly attractive is the possibility to treat a previously cleaned or lightly contaminated cryostat without prior disassembly (but with detectors removed), e.g., after it has been re-opened for corrective action.

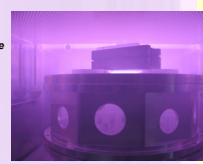
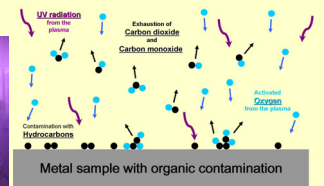
The paper describes the principles of plasma cleaning, its general technical realization, the practical application, and possibilities for adaptation to specific needs. Various qualitative and quantitative measures of the efficiency of plasma cleaning are presented and as an example of successful plasma-cleaning: the very large OmegaCam cryostat [Olaf Iwert et al.: The OmegaCam 16k by 16k CCD detector system for the ESO VST (abstract submitted to SDW2005)].

Plasma Cleaning Process

During plasma cleaning the surface is cleaned

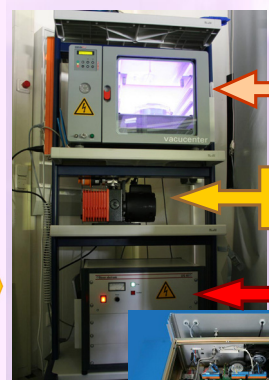
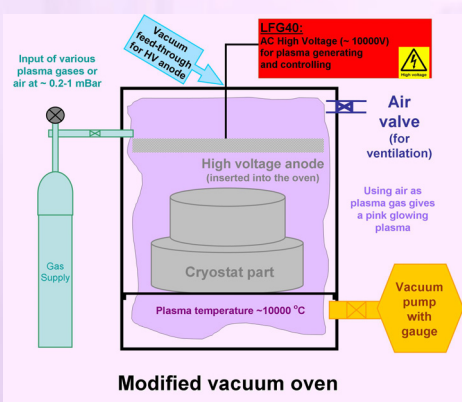
- physically by ion bombardment (like sand-blasting)
- chemically e.g. by active oxygen (oxidation and reduction).

Plasma cleaning in process



Using air as plasma gas gives a pink glowing plasma.

Realization of Plasma Cleaning



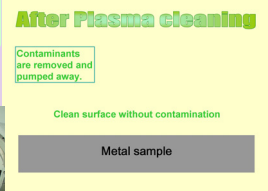
- Conventional vacuum oven, equipped with a high voltage anode
- Powerful dry vacuum pump: Alcatel ACP28
- High voltage plasma controller: Diener Electronic LFG40 (www.diener-electronic.de)

Plasma Gases

- Oxygen - best for cleaning of aluminium and stainless steel
- Ambient air - sufficient for normal cleaning
- Argon - Cleaning without chemical reaction
- Hydrogen - Best for cleaning of gold, silver and copper
- Nitrogen - Similar as Argon
- Flour-containing gases - Chemical cleaning
- Mixtures of gases

Plasma Cleaning Result

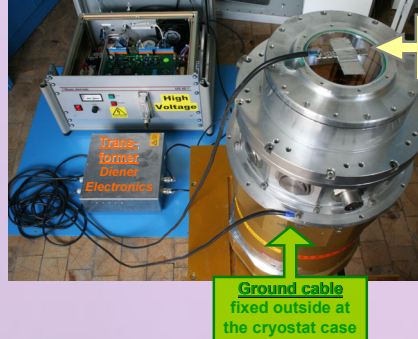
A plasma cleaned cryostat part must be handled strictly under ultra-clean condition to avoid recontamination.



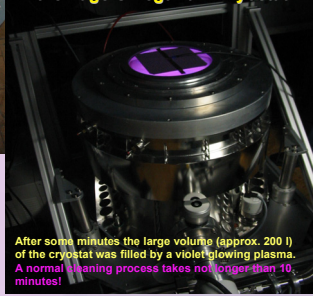
OmegaCam cryostat inside the clean-room

Special Plasma Cleaning

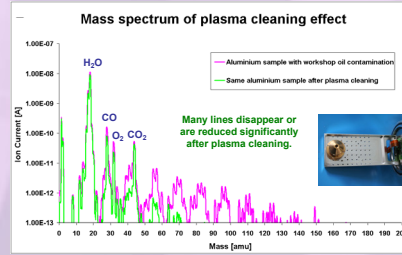
Plasma cleaning inside every assembled cryostat (no disassembly necessary!)



Successful plasma cleaning inside the huge OmegaCam Cryostat



Test with Mass Spectroscopy



Test with Water Drop Method

An aluminium sample, which is contaminated shows a round water drop on its surface. After the plasma cleaning there is less adhesion, therefore no water drop is possible on the surface and the water is flowing away.



Materials for Plasma Cleaning

- Plastic parts: Plasma-time < 10 min.
- Printed circuit boards
- Gold-plated metal parts
- Vacuum connectors
- Metal parts (stainless steel, Aluminium): Plasma-time 1 min. - 1 h

Safety Precautions

- Exhaust gases: should be lead away through a fume hood.
- High voltage: Effective electrical insulation is necessary.
- UV radiation: is absorbed by the cryostat or oven window.

