

Extracting the electron-induced molecular desorption coefficient using an electron detector

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Abstract

This article is a summary of the work presented in Refs. [1, 2]. In the following, we present the main topics discussed on them. For more information, see those articles and references therein.

INTRODUCTION

Valuable information can be extracted from the electron detectors, provided that they are properly calibrated. In this case, the extracted information is the electron flux into the wall and its energy spectrum. This allows to infer the electron-induced molecular desorption coefficient for both baked and unbaked stainless steel surfaces.

SYSTEM CALIBRATION

A significant number of electron detectors are installed in different machines to evaluate the electron cloud effects. However, often they are not properly calibrated and hence only qualitative information can be inferred.

This work enhances the usefulness of a proper calibration of the electron detectors. These calibrations are:

- Detector transparency – evaluate the ratio between the number of electrons at the collector plate and the number of electrons that hit the accelerator chamber wall.
- Bandwidth calibration – evaluate the effect of the system electronics and/or cable length.

These calibrations provide the electron flux to the wall for a given electron signal (typically, a voltage reading in the scope located at the service area). This information can then be used for:

- Calculation of important surface chamber parameters. For instance, using the electron flux to the wall and the pressure signal, the electron-induced molecular desorption coefficient can be inferred.
- Proper benchmark with the computer simulation codes.

ELECTRON-INDUCED MOLECULAR DESORPTION COEFFICIENT

The analysis of the experimental data in Refs. [1, 2] shows a linear relation between the pressure and the electron flux into the wall. For unbaked stainless steel and assuming *CO* as the only desorbed gas, this value is about

0.05 moles/electron at the beginning of the run, and decreases to 0.01 after 6 weeks of machine operation due to scrubbing. For baked stainless steel, this value is around 0.005 moles/electron.

ELECTRON ENERGY SPECTRUM DURING MULTIPACTING CONDITIONS

The desorption coefficient strongly depends on the striking electron energy at the beam-pipe wall. This is why a measurement of the electron energy spectrum is of great importance. References [1, 2] show that for unbaked stainless steel, a measure of the energy spectrum shows a large peak around 15 eV, and that the spectrum extends to at least 350 eV. The measurement is in a generally good agreement with the spectrum obtained using CSEC computer simulations.

CONCLUSIONS

A proper calibration of the electron detector allows to infer the electron flux into the wall, and using the pressure readings, the electron-induced desorption coefficient is inferred for baked and unbaked stainless steel surfaces at RHIC. Desorption coefficient for baked surfaces are about one order of magnitude lower than for unbaked surfaces, and results are consistent with laboratory measurements. The measurement of the electron energy spectrum peaks at about 15 eV and extends to about 300 eV, and are in a good agreement with computer simulation results.

REFERENCES

- [1] U. Iriso and W. Fischer. Electron induced molecular desorption from electron clouds at the Relativistic Heavy Ion Collider. PRST-AB, 8, 113201 (2005).
- [2] U. Iriso, PhD Thesis in the Universitat de Barcelona, Theory, observations, and simulations of the electron cloud at RHIC, to be published, 2005.