Heavy ion induced desorption measurements on cryogenic targets *

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Introduction

Heavy ion impact induced gas desorption is a key process that drives beam intensity limiting ionization losses in heavy ion synchrotrons. Minimizing this effect, by providing low desorption yield surfaces, is an important issue for maintaining a stable ultra high vacuum during accelerator operation with medium charge state heavy ions. At room temperature the desorption yield per incident ion η is known to scale with the electronic energy loss at the surface [1]. Nevertheless, measurements with the prototype cryocatcher for SIS100 showed a different scaling [2], which needs to be understood. An experiment to systematically examine this behaviour is presented. The cryogenic beam-induced desorption yields at different temperatures and for different beam parameters are investigated.

Experimental Setup

The experiment described in this article has been set up at the SIS18 at GSI. Its UHV system is connected to the accelerator's beamline via a differential pumping line, containing a conductance limiting pipe with small diameter. In the target area a pressure in the 10^{-10} mbar regime has to be reached in order to clearly resolve the desorption peaks. Therefore, the setup is partially baked. The cryogenic target has the geometry of the SIS100 cryocatcher's front part and is cooled by a coldhead. It gets hit by a fast extracted 1μs beam pulse. Gas desorbed by the beam impact spreads in the diagnostic volume which is well defined by the pipe mentioned above. The pressure evolution is measured an extractor gauge. A more detailed description of the setup is given in [3].

Methodology of the measurements

The extraction of the beam from the synchrotron triggers a fast pressure measurement of 10 s duration. It allows a fine resolution of pressure rise and relaxation, out of which the amplitude of the pressure peak is determined. By using the ideal gas law and the number of beam particles a desorption yield is obtained. The temperature of the target is varied by a heater and by activating and deactivating the coldhead. Measurements at intermediate temperature levels were taken with a thermally drifting target.

Results

The determined desorption yield η is plotted in figure 1 against the beam energy for different experimental parameters. At or close to room temperature the known scaling with the electronic energy loss at the surface could be observed. However, at cryogenic temperatures the scaling looks different than at room temperature, which is not yet understood. An accordance with earlier measurements with the cryocatcher protoype [2] could not yet be found.

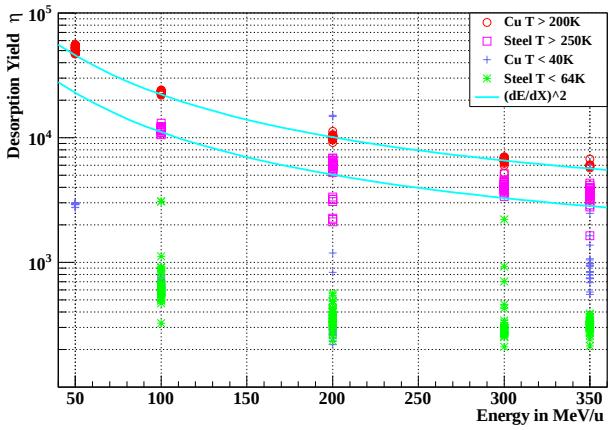

Figure 1: Comparison between the energy dependance of η for different experimental parameters.

Outlook

Data obtained from this experiment is still undergoing analysis, so no concluding statement can yet be made. A central part of this analysis will be a gas dynamic simulation to better understand the influence of de/adsorption on the setup's other cold/warm surfaces. Different experimental geometries are also bound to factor into the results, which will also be investigated by this method.

References

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