Outgassing Behaviour in Ultra-High Vacuum

Measurement of the Emissions of an ANR101/RES in Ultra-High Vacuum

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Introduction

Experiments in ultra-high vacuum (UHV) conditions require highest precision and care in manufacturing of the respective equipment. The outgassing behavior is a crucial factor when researchers decide for new instruments in their setups. This application note describes measurements of the outgassing data of an attocube rotator with an integrated resistive encoder ANR101/RES/UHV (see Figure 1). The tests were carried out by Christian Kalus and Stefan Eisebitt at the BESSY synchrotron facility in Berlin, Germany, who generously provided their data.

Figure 1: Ultra compact attocube rotator ANR101 with 30 mm diameter and 15.2 mm height.

Setup

The test and measurement setup consists of two parts:

a) Measurement of the reference mass spectrum of the empty vacuum chamber (green curve in Figure 2)

b) Measurement of the mass spectrum of the vacuum chamber, after inserting the attocube rotator (blue curve in Figure 2).

The vacuum chamber was baked out for three days at a temperature of 180° C. The turbo pump used had a pumping power of 180 l/s for N_2. After cooling down to room temperature a pressure of $7.3 \cdot 10^{-11}$ mbar was measured and a mass spectrum was taken.

Measurement Results

Afterwards the rotator ANR101/RES/UHV was inserted into the vacuum chamber and baked out again for three days at 100°C. Due to this procedure, an end pressure of $8 \cdot 10^{-11}$ mbar could be achieved. The measured mass spectrum is shown in Figure 2 (blue curve).

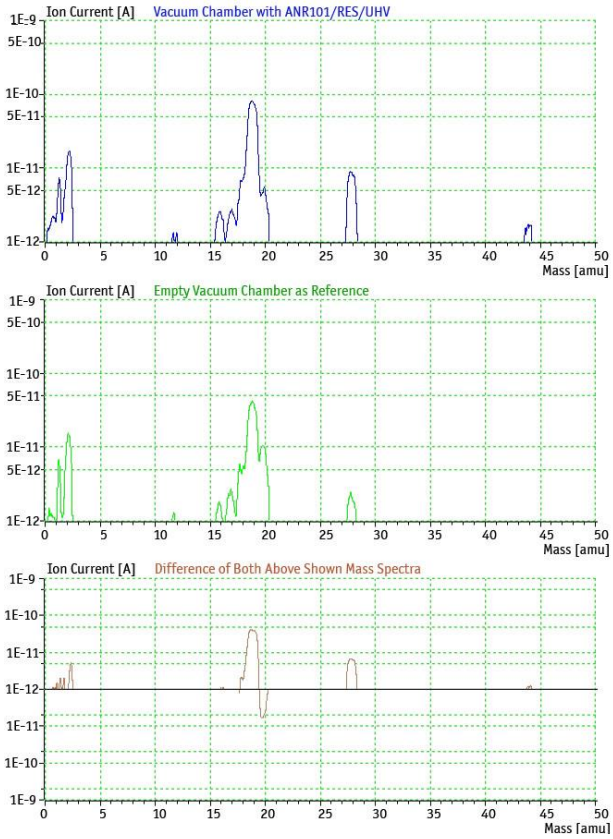

Figure 2: UHV outgassing data measured at BESSY synchrotron facility in Berlin. Blue curve: mass spectrum of the vacuum chamber with an ANR101/RES/UHV inside. Green curve: reference mass spectrum of the empty vacuum chamber. Brown curve: Difference of both mass spectra. The peaks refer to additional emissions caused by the ANR101/RES/UHV.

The third (brown) curve in Figure 2 illustrates the difference between both mass spectra. As can be seen from this curve, the emissions added by the rotator are at remarkably small levels. The peaks that are visible in the spectrum mainly refer to H_2O, CO, N_2, and CO_2, i.e. elements that were present in the chamber before. It is expected that these peaks can be further reduced by an increased bake out temperature and duration.

Conclusion

In summary, this means that the positioner is perfectly suited for UHV use. These experiments are an example for the outstanding UHV compatibility of the attocube systems positioning systems, which are specified to pressures down to $5 \cdot 10^{-11}$ mbar.