# Vacuum Performance Test of CuCrZr Photon Absorbers

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## *Abstract*

To test the pumping performance of NEG coated CuCrZr absorber, we performed a comparative experiment on the two absorbers, one with NGE coating and the other one without coating. First, we run the Monte Carlo simulation by using MolFlow+ code to estimate the pressure inside test chamber at different thermal outgassing rate. And then two absorbers are mounted inside the chamber for the pressure vs. time profiles testing. The experimental set-up and pressure profiles will be presented here.

## INTRODUCTION

We have developed two absorbers made of CuCrZr materials. The CuCrZr alloy is the right material for handing high heat load of synchrotron radiation. It has high yield and tensile strength, it has much lower cost than GlidCop, also it can be easily welded with stainless steel(no brazing process) and also UHV compatibility. The two absorbers were similar in structure and the vacuum sealing flange was integrated with the absorber without any brazed or welded junctions. The 1st absorbers is similar to ALBA absorber structure [1] and the part of the surface have NGE coating (Fig. 1). The other one refers to the ESRF EBS [2] absorber structure but has no NEG coating on its surface. ( Fig. 2). These two absorbers were made up by SAES RIAL and 1st one NEG coated by SAES Getters.

This experiment is to measure the pump-down curves of two absorbers and to see whether the NEG coating on the absorber has pumping effect. In the following sections, we will show the experimental set-up and present the measurement results.

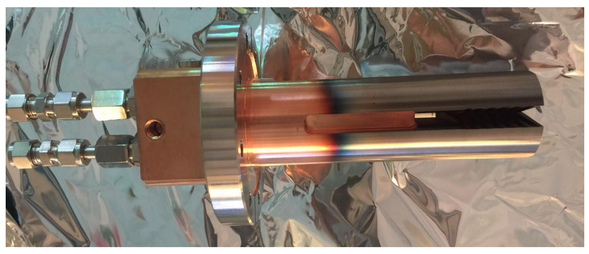

Figure 1: 1st absorber with NEG coating

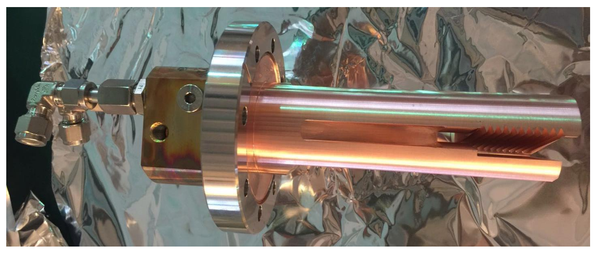

Figure 2: 2nd absorber without NEG coating

## MONTE CARLO SIMULATION

In order to choose the structure of a reasonable experimental system, we performed a simulation calculation using the Monte Carlo simulation code MolFlow+ which was developed at CERN [3].

We designed two types of experimental systems. One was to connect the vacuum chamber directly with a 150L ion pump. The other was to add a 10mm diameter orifice conductance to the ion pump port. The simulation model are shown in Fig.3. The simulated pressure results at different thermal outgassing rates are shown in Table 1.

Table 1: Simulation Parameters and Results

| Assumed Vacuum Chamber Thermal Outgassing Rate 2E-10 mbar L/s/cm^2 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Assumed Absorber Pumping Speed on NEG Surface 0.3L/s/cm^2 | | | | | | | |
| Assumed Absorber Thermal Outgassing Rate on Without NEG Surface (mbar L/s/cm^2) | | | 5E-10 | 1E-10 | 5E-11 | 1E-11 | 5E-12 | 1E-12 |
| Pressure (mbar) | Without Orifice | Without NEG film | 1.24E-9 | 2.80E-10 | 1.62E-10 | 6.60E-11 | 5.36E-11 | 4.44E-11 |
| | | With NEG film | 4.77E-10 | 1.20E-10 | 7.51E-11 | 4.16E-11 | 3.65E-11 | 3.30E-11 |
| | With Orifice | Without NEG film | 2.05E-8 | 4.63E-9 | 2.60E-9 | 9.68E-10 | 7.68E-10 | 6.04E-10 |
| | | With NEG film | 1.45E-9 | 3.48E-10 | 2.18E-10 | 1.07E-10 | 9.46E-11 | 8.15E-11 |

## REFERENCES

[1] M. Quispe et al. “Development of the Crotch Absorbers for ALBA Storage Ring”, MEDSI 2008
[2] E. Gagliardini et al. “A NEW GENERATION OF X-RAY ABSORBERS FOR THE ESRF EBS STORAGE RING”, MEDSI 2016
[3] M. Ady and R. Kersevan, “Molflow User's Guide”
[4] SAES Getters S.p.A. “NEG coating activation procedure”
[5] C. Herbeaux et al. “NEG COATED CHAMBERS AT SOLEIL: TECHNOLOGICAL ISSUES AND EXPERIMENTAL RESULTS”, EPAC’08, THPP147

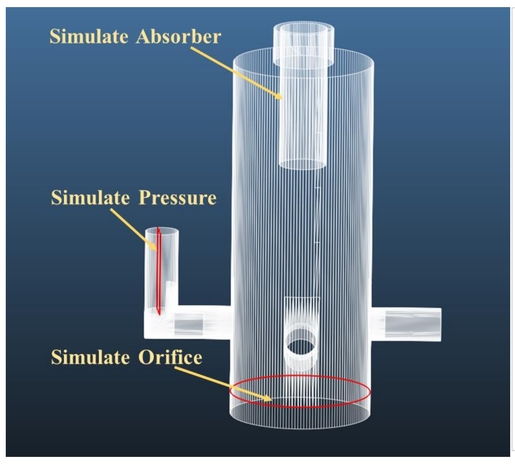


Figure 3: Simulation model

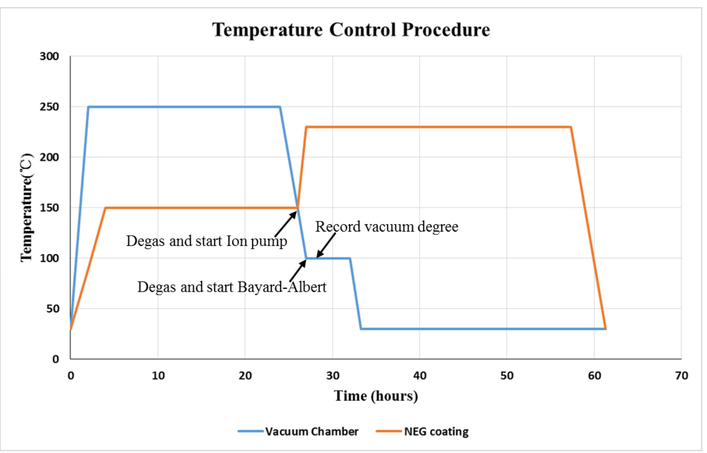


Figure 4: Temperature Control Procedure

## EXPERIMENTAL PROCEDURE (FIG.4)

- Assemble the vacuum system including one of two absorbers and flanges.
- Put on the heating equipment (thermocouples and heating tapes) in three parts (absorber and vacuum chamber up and down).
- Start pump-down by primary pump and TMP.
- Switch on Helium Mass Spectrometer Leak Detector to perform leak detection.
- Keeping TMP pumping.
- Bake-out for 24 h, heating stainless-steel vacuum chamber components up to 250℃ and absorber parts to 150℃, respectively.
- At the end of the 24 h bake-out, start NEG activation by heating up NEG-coated parts to 230℃. Keep activating at the temperature for 24 h. When the temperature of the NEG-coated parts increases, cooling down stainless-steel vacuum chamber ones to 100℃ and maintaining for about 5h.
- When the vacuum chamber temperature down to 150℃, flash the sputter-ion pumps and keep it switched on. When the vacuum chamber down to 100℃, degas the vacuum gauges and let it on to the end.
- When vacuum chamber temperature is cooled down to 100℃ for 1 hour, close the valve to isolate the vacuum system and the molecular pump and start to record the pressure.
- Cool down the system to room temperature.
- Continue to record the pressure 12 to 13 hours for the pressure profiles.

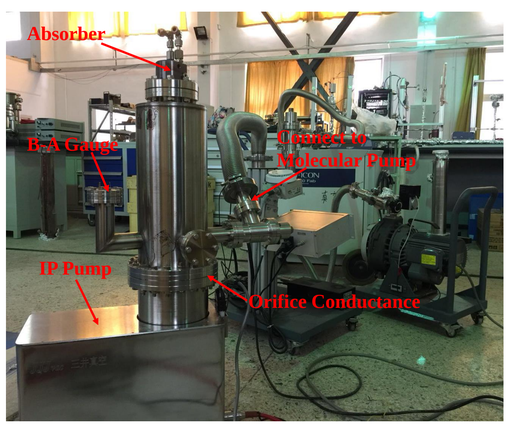


Figure 5: Experimental Set-up

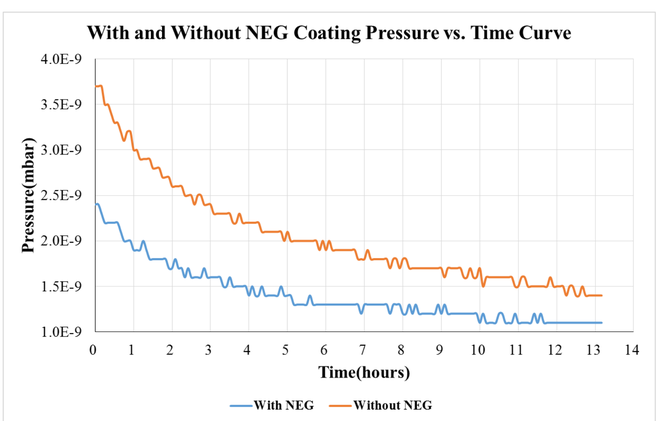


Figure 6: Pressure vs. Time Curve

## PRESSURE CURVES AND CONCLUSION

We set up a test system (Fig.5) and conducted the experiments on two absorbers(one with NGE coating and the other one without coating). The two test conditions were kept as same as possible. Comparing the pressure vs. time curves of the two experiments, the NEG-coated absorber has a lower pressure (Fig.6). This shows that the NEG-coated one has some pumping effect, and more coated surface area may help pumping more. Further investigation will be needed.