# Offline test for RF carpet transportation in RF ion guide gas cell at the SLOWRI facility

A. Takamine,*1 M. Rosenbusch,*1 M. Wada,*1,*3 P. Schury,*3 J. Y. Moon,*4 T. Sonoda,*1 T. M. Kojima,*1 I. Katayama,*1 Y. X. Watanabe,*3 H. Ueno,*1 and H. Ishiyama*1

We are developing an RF ion guide[1)] gas catcher cell (RFGC) at the SLOWRI facility. Instead of the previously-used cylindrically shaped gas cell, we recently introduced a newly-designed cuboid-shaped gas cell to improve the heat conduction between the cell and a cryocooler. At the same time, we redesigned an RF carpet (RFCP) configuration consisting of two stages of RF-transport electrodes, which is one stage less than that in the previous version[3)] (see Fig. 1). Although the 1st RFCP has been unchanged, the 2nd RFCP now has concentric electrodes to collect ions to the exit hole at the center of the RFCP (Fig. 1(b)). Since the RFCPs are mounted onto the lid (an aluminum plate) of the gas cell, the thermal conductance has been improved and the RFCPs are efficiently cooled down.

We tested the transport performance of the RFGC using a surface ionization Cs ion source placed at the inner wall of the gas cell. The 1st RFCP carries ions to the 2nd RFCP, and the ions are guided to the exit hole by the 2nd RFCP. Firstly, we measured the ion currents collected onto the 1st RFCP by using the 1st RFCP as a Faraday cup, and then transported the ions through the 1st RFCP. After that, the ions were transported to the 2nd RFCP by applying the RF and DC fields to the 1st RFCP. The efficiency was defined by the current measured at the 2nd RFCP divided by that measured at the 1st RFCP. The test was typically performed with currents in the order of a few nA at the 1st RFCP. Figure 2 shows one example of the obtained transport efficiency as a function of the RF voltages applied to the 1st RFCP for three different helium gas pressures. The results show a transport efficiency of ≈60% at pressures of 13 kPa and less.

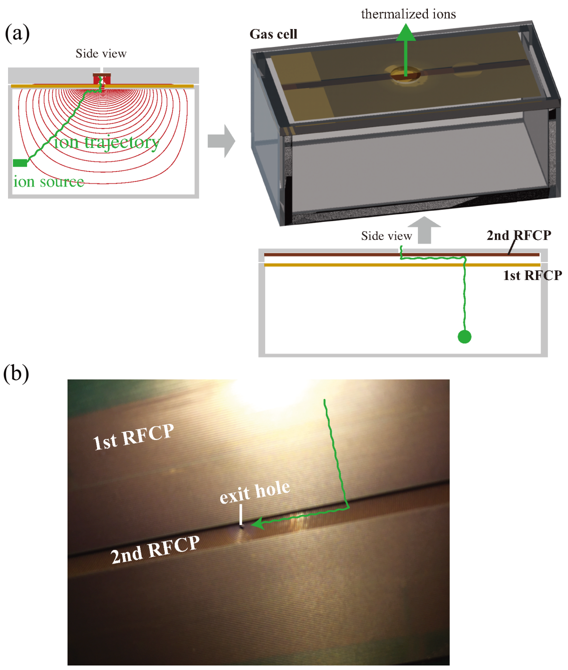


Fig. 1. (a) Sketch of the RFGC with an ion trajectory (green line). Red lines depict equipotential surfaces. (b) Photo of the center region of the RFCPs.

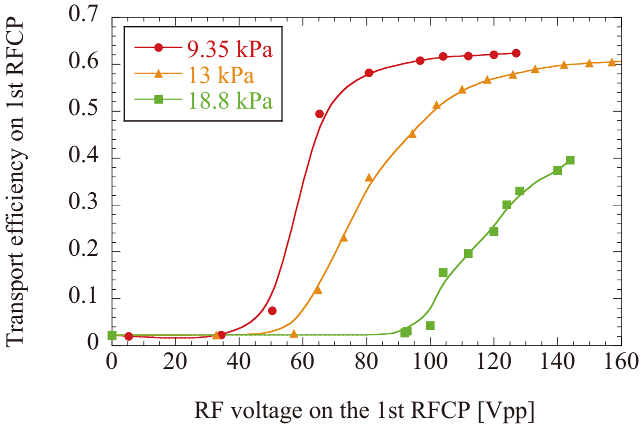


Fig. 2. 1st RFCP transportation test results for three different He gas pressures, namely 9.35 kPa, 13 kPa, and 18.8 kPa. In this test, the drag dc field on the 1st RFCP was 11.7 V/cm and the extraction DC field between the 1st and 2nd RFCPs was 20 V/cm.

We subsequently extracted the ions from the exit hole using an ion surfing technique[4)] on the 2nd RFCP, and the extracted ions were detected by a Faraday cup behind the 2nd RFCP. The extraction efficiency was measured to be ≈ 80%. Therefore, the total efficiency in the present RFCP configuration was obtained to be ≈50%.

We will continue the test for an RFCP with finer pitch, and will try to use an ion surfing type RFCP as the 1st RFCP instead of the DC+RF type used in this measurement. We are now preparing the ion-guide system to be placed behind the 2nd RFCP; it consists of a quadrupole ion beam guide and an ion trapping system. This low-energy RI beam provider will be connected to a multi-reflection time-of-flight mass spectrograph (MRTOF-MS). We plan to start online commissioning of the RFGC in FY2019 at the end of the ZeroDegree beam line.

*1 RIKEN Nishina Center
*2 Quantum Metrology Laboratory, RIKEN
*3 Wako Nuclear Science Center (WNSC), IPNS, KEK
*4 Institute for Basic Science

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