A.9: Preliminary vacuum performance results of newly developed sputter ion and non-evaporable getter combination pump

Synchrotron radiation source (SRS) must operate at a dynamic pressure below 1×10^{-9} mbar to minimize beam-gas scattering for increasing the lifetime of the stored electron beam. Bending magnet chambers of the future High Brilliance Synchrotron Radiation Source (HBSRS) requires pumping of large photon induced desorption (PID) gas load at downstream end of the chamber. Pumping solution for handling the large PID gas load requires higher pumping speed for hydrogen and carbon-monoxide (CO) in ultra-high vacuum (UHV) condition. Multi-bend lattice of HBSRS leaves very small space for the ultra-high vacuum (UHV) pumps. Conventionally, sputter ion pump (SIP) with titanium sublimation pump (TSP) combination is used for such pumping solution. But there are certain limitations with SIP+TSP combination such as: particulate generation by TSP filament during flashing, bulky and large size requiring higher space and breaking of ring vacuum for replacement of exhausted filament. To counter these issues, a SIP+ non evaporable getter (NEG) combination pump is used as advanced pumping solution. To meet the requirements of future HBSRS project, efforts were launched for the development of this type of combination pump and recently one SIP (with pumping capacity ~35 l/s for nitrogen) with a NEG module (with pumping capacity ~400 l/s for hydrogen) combination was developed and tested for gauging its initial static vacuum performance.

Advantages of SIP+NEG combination pumps are: (i) particulate free operation, (ii) very compact requiring less space, (iii) higher pumping speed for hydrogen and carbon monoxide gases in UHV range below 1×10^{-9} mbar level, and no power requirement by NEG module for its operation.

In this design, an in-house developed SIP (with 35 l/s for nitrogen) is integrated with imported NEG module (400 l/s pumping capacity). Hot cathode ionization gauge (Bayard-Alpert gauge) is used for ultimate pressure measurement and residual gas analyzer (1-100 amu) is used for partial pressure measurement during the characterization studies. Ultimate pressure attained by the standalone SIP is 2×10^{-10} mbar after bake out at 250 °C for 24 hour duration, whereas, 2.4×10^{-11} mbar ultimate pressure has been achieved with the SIP+NEG combination pumping system after a bake out at 250 °C for 24 hour and followed by the activation of NEG module at 550 °C for an hour. Achievement of this level of UHV is a major milestone, which is one of the important desired characteristics of this type of combination pump.

Figures A.9.1 to A.9.3 show the photograph of combination pump vacuum test setup and the test results.

Preliminary results show that the combination pumps reduce the ultimate vacuum by one order due to higher effective speed of NEG for hydrogen in UHV range. Detailed vacuum characterization is under progress.

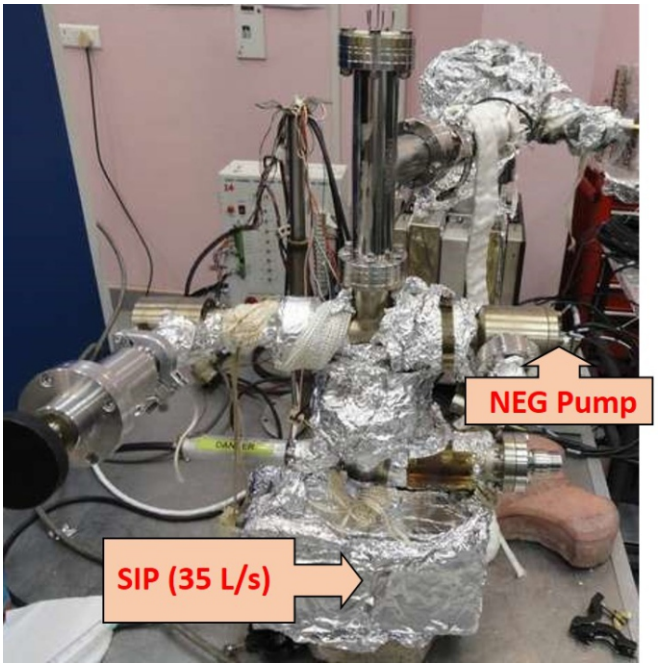

Fig. A.9.1: In house developed SIP+NEG combination pump test set-up.

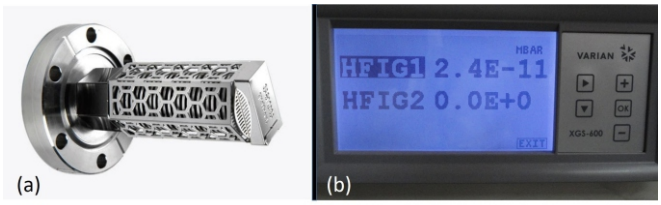

Fig. A.9.2: (a) Enlarged view of NEG pump element.(b) Ultimate pressure reading by B-A gauge controller with SIP+NEG.

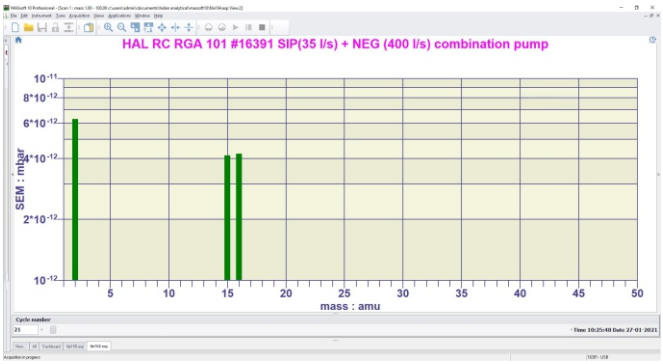

Fig. A.9.3: Residual gas spectrum scan at ultimate vacuum condition.

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