SHOP NOTES

These are "how to do it" papers. They should be written and illustrated so that the reader may easily follow whatever instruction or advice is given.

CF16 differentially pumped window for ultrahigh vacuum applications

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For the spectroscopy of gas phase molecules, ions, and surfaces in UHV setups, leak-tight infrared window assemblies are mandatory. While flange-sealed windows are commercially available for materials such as ZnSe, CaF_2, or even chemical vapor deposited (CVD) diamond, they are either too expensive, not available, or simply just do not work for alakali halides, KRS-5, HDPE, or TPX. Latter three window materials are especially interesting for far infrared (FIR) applications, as is also diamond. Therefore, differentially pumped O-ring sealed window assemblies based on CF35 flanges[1,2] have been proposed in the literature. Their advantages are good vacuum performance and easy interchangeability of the window material.

For the spectroscopy of ions in an ion trap setup, we needed a "simple as possible" differentially pumped window assembly which fits on a small CF16 flange, and the resulting construction is shown in Fig. 1. It can house an IR window of 25 mm in diameter (thickness arbitrary) for transmission or even a 1 in. mirror for reflection of a laser beam. The clear aperture in this construction is only 8 mm, although this size can be easily increased. In comparison to the earlier designs of differentially pumped windows,[1,2] it is small and uses only two sealing O-rings of 3 mm thickness whose interspace is pumped via a tube welded into the outer rim of the assembly. A third O-ring contained in a circular cap can be used to hold the window/mirror and press it slightly against the sealing O-rings if required, although the construction works as well without it. Relatively thick O-rings have been chosen to guarantee a good sealing and to prevent metal parts from touching the window. Furthermore, to avoid air pockets on the UHV side, instead of using a retainer for the inner O-ring, the bed of the inner O-ring is curved as seen in Fig. 1. This curved bed offers a bigger sealing surface for the O-ring and prevents it from being sucked inside the vacuum. As a final advantage, the window is easily accessible also at the sides in case it would stick to the O-rings after baking.

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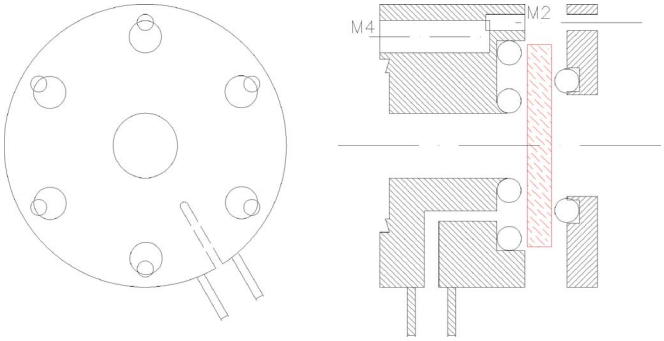

FIG. 1. Typical construction of O-ring sealed differentially pumped window on a CF16 flange. The three Viton O-rings have a thickness of 3 mm and inner diameters of 8, 13, and 20 mm, respectively.

The assembly has been tested on two different leak testers (Edwards 3000 and Leybold 200+), as well as on the ion trap apparatus during IR spectroscopic studies of small molecular ions. The tested windows were usually 3 mm thick (KRS-5, HDPE, and TPX), and also a 0.6 mm thick CVD-diamond window has been utilized. Using KRS-5 or diamond as window materials, no leak could be detected beyond the leak tester sensitivity limit of about 10^{-11} Torr l/s, and the trap apparatus showed a pressure in the range of 4×10^{-10} Torr after bakeout, the same pressure when using a CF16 blank. For the other two FIR window materials, some permeation of gases could be observed in all tests, increasing the chamber pressure by about 1×10^{-10} Torr. The window assembly has been repeatedly baked at about 80 °C (higher temperatures are possible). As experienced in the other window constructions,[1] after bakeout, the chamber pressure rises only very slowly if the interspace of the window assembly is not pumped.

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