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ROTATING AND RECTILINEAR PROBE MOTION WITHIN A CONE ANGLE OF 34°

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Rotating and rectilinear probe motion within a cone angle of 34°

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Abstract A probe holder is described which can transmit tilting and rectilinear motion to a vacuum system from the outside with added vacuum safety while moving the probe. It consists of a spherical part which can rotate within a two-section housing. Rectilinear motion is obtained with a piston ring seal through this sphere. Thus the probe is movable within a cone angle of 34°. The probe holder can be used with vacuum systems for plasma research as well as with coating units for various possible applications and it can be machined easily with a lathe.

1 Introduction

Transmission of motion to a vacuum system from the outside is usually achieved through complicated mechanisms but most of these devices are limited in their movement and transmit either rotation or rectilinear motion to the vacuum system. Although there are some mechanisms that can transmit three-dimensional motion to the vacuum system (Retzloff 1949, Lee and Young 1954), these should also be vacuum safe, easily cleaned and adaptable to any vacuum system. The probe holder to be described here can transmit rectilinear motion, rotation and lateral motion within a cone angle of 34° with added vacuum safety while motion is being transmitted to the probe. If proper O rings are used, it can be baked within the temperature limitations of the O rings. The holder is versatile enough to be used with probes, waveguides or any other measuring equipment. It is adaptable to vacuum coating units to move substrates, change masks or load evaporating sources. With proper feedthroughs, it could also be used as a filament holder to change the position of the evaporating sources within the coating unit while the evaporation is taking place.

The probe holder consists of two basic components. The first one is spherical in shape and can rotate about its centre, giving the holder its rotating and tilting motion. Rectilinear motion is achieved by a piston ring seal that passes through the axis of the spherical part. The second component is made

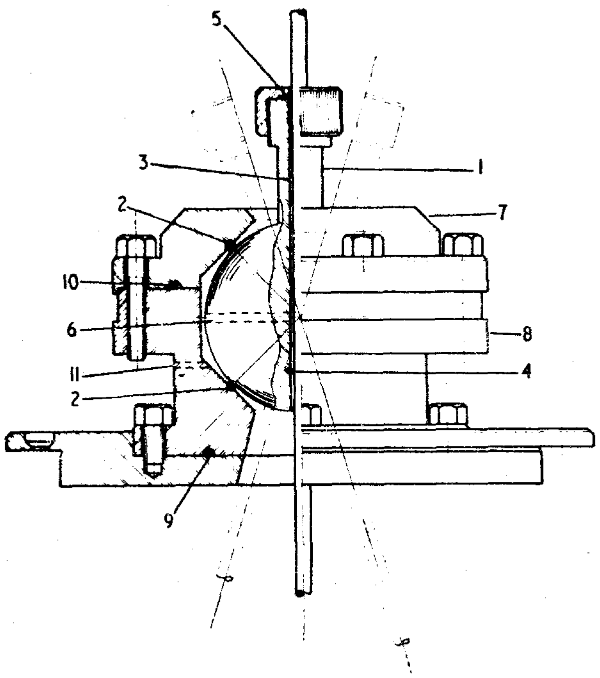

Figure 1 Assembled drawing of the probe holder

in two sections and houses the spherical holder. Connection to the vacuum system is made by means of the lower part of the housing.

2 Construction

The assembled unit is shown in figure 1. The rotating spherical part consists of a spherical body 1 of solid brass with a cylindrical extension along an axis. The spherical part is machined on a lathe and has a spherical accuracy of 0·025 mm. The diameter D of the sphere depends on the internal diameter of the O rings 2 that are used for vacuum sealing, being made equal to $\sqrt{2}d_i$, where d_i is the internal diameter of the O rings. A hole 3 is drilled along the axis of the cylinder and sphere, of slightly larger diameter than that of the probe, so that the probe will slide easily within the hole. Two O rings are placed in the hole. One is located on the lower part of the sphere (4) and acts as a piston ring seal for long travel. The other (5) is placed at the top of the cylinder and is a regular muff-coupling for sealing glass or other tubing into the vacuum system. A hole 6 is drilled through the equator of the sphere to connect the space between the muff-coupling and the piston ring seal to the space between the two housing sections. The housing is also made of brass and consists of two demountable parts 7 and 8 which press the two O rings 2 on to the sphere to maintain the vacuum seal. The lower part is used to connect the probe holder to the vacuum system by an O ring 9 with a proper groove. Another O ring 10 is used between the two parts of the housing for vacuum isolation. There is an O-ring groove on each of these demountable parts. The locations of these grooves are such that when the system is assembled, the O rings 2 press on to the sphere from 45° above and below the equator of the sphere. The diameters and dimensions of these O ring grooves are chosen so that the pressure on the O rings will maintain the necessary vacuum seal as well as allow easy rotation of the sphere within its holder. Both the top and bottom sections have conical openings machined on them for unobstructed motion of the probe within a given angle. A hole 11 is also drilled in the lower part of the housing to evacuate the spaces between the pair of O-rings and the muff-coupling and the piston ring seal by connecting this hole to the roughing line of the pumping system. This ensures vacuum safety while motion is transmitted to the probe.

3 Assembly

After thorough cleaning of all parts of the system, the lower O ring is placed in its groove and the sphere is placed on to this O ring. By carefully placing the upper O ring in its groove, the upper part is gently placed on to the sphere from the top. It is not necessary to grease the O rings, but if the device is to be left on a vacuum system for a long period of time, greasing helps to prevent sticking of the spherical part between the two O rings. The screws are tightened carefully to maintain the proper pressure on these O rings. This procedure is tested by rocking the sphere from the top so that it rotates easily within its housing. Next the probe is inserted into the hole and care is taken not to tear the O ring in the piston ring seal groove. The muff-coupling is then tightened, the holder is connected to the vacuum system and tested for possible vacuum leaks. The four probe holders built in our machine shop did not limit the pressure of the vacuum system, which was about 1 μTorr and these tests were run without evacuating the spaces between the O-ring pairs. Rotating and tilting motions are obtained by rotating and/or tilting the sphere in its housing. Rectilinear motion is obtained by loosening the muff-coupling and moving the probe through the piston seal. The muff-coupling is then tightened to secure the probe. The probe can now be tilted or rotated about this position within the cone angle of 34°.

A special vacuum connection is shown in figure 1 that is used with a commercial vacuum coating unit. Connection to a vacuum system can also be made permanent by soldering the lower part to the vacuum chamber, thus removing the O ring 9 from the system.

References

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