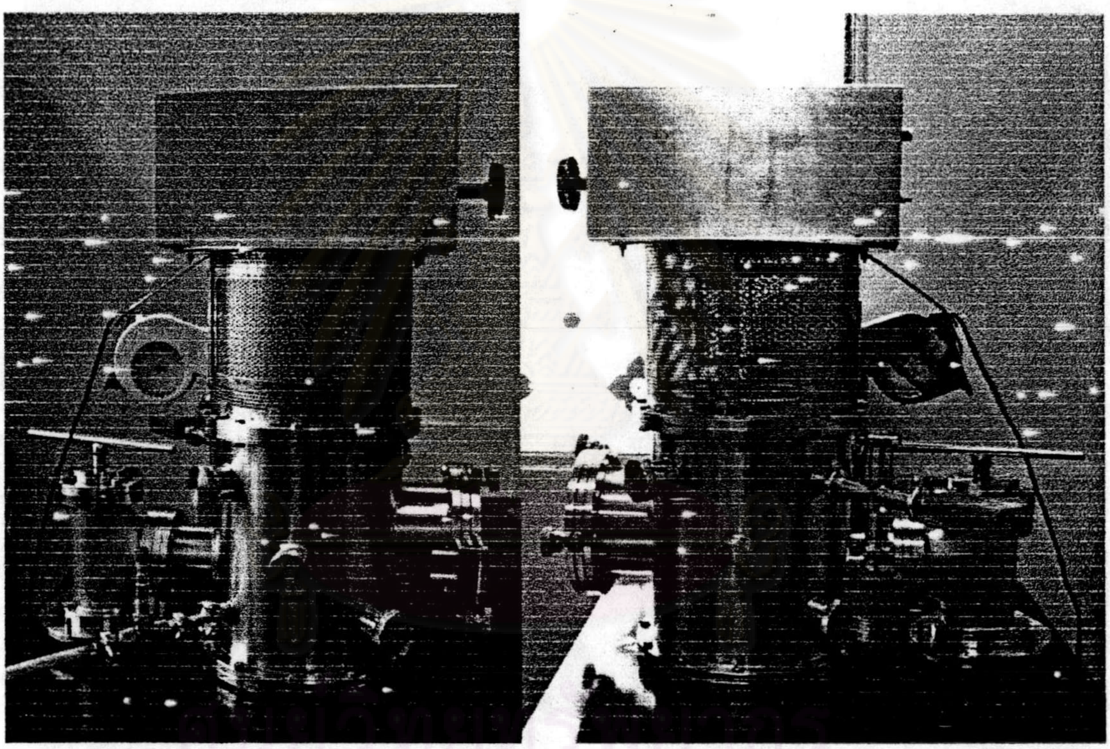
CHAPTER 4

DESIGNED SYSTEM AND PERFORMANCE

In this work, the design of components of the RF-PECVD system is important to the performance of the system. The components designed are reactor chamber, gate vale and matching cage. Detailed description of the RF-PECVD system components and the performance of the system are given in this chapter.



(A) (B)

Figure 4.1: Showing the Left (A) and Right (B) view of the chamber, gate valve and matching cage

4.1 System construction

The first component of designed system is the reactor chamber. It is designed for thin film coating by RF-PECVD technique and plasma diagnostic. Stainless steel is the main material is used to construct the reactor chamber. Details drawing of the reactor chamber components are demonstrated in Appendix A. Photograph of the reactor chamber is shown in Figure 4.2.

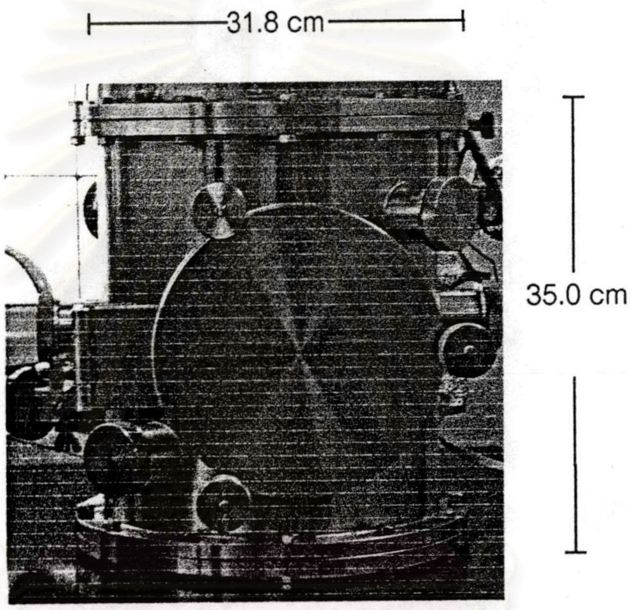


Figure 4.2: Photograph of the reactor chamber

The reactor chamber is made of stainless steel in cylindrical shape with 265 mm in internal diameter, 300 mm tall, and 4 mm thick wall. It has six NW 40 ports and two NW 25 ports. One of the NW 25 port at the top is used to connect to the pressure gauge and another to the gas supply outlet. The reactor chamber has an opening at the top, where a quartz plate is placed to cover the opening. O-rings are used as vacuum seals. Diagram of the reactor chamber is shown in Figure 4.3.

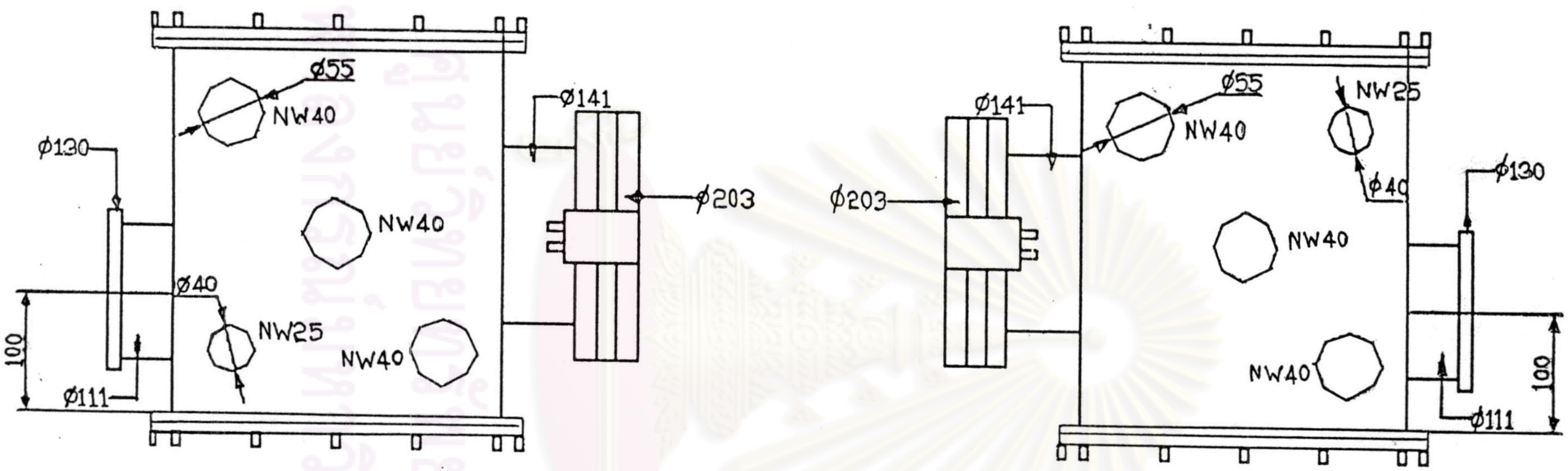


Figure 4.3: Diagram of reactor chamber (in mm unit)

The reactor chamber connects to vacuum pumping system through an ISO 63 port. The vacuum chamber is evacuated by Edwards EXT 70 turbomolecular pump backed by a two stage RV 12 rotary vane pump (see appendix B). The base pressure of the system is in the order of 10^{-5} torr. Edwards active pirani gauge and Edwards active inverted magnetron gauge are used for monitoring the pressure of the chamber.

In this work, it is necessary to adjust and control the pressure of RF-PECVD system to the desire value. For pressure control, gas is introduced into the reactor chamber via gas feed control. The pressure of reactor chamber of RF-PECVD system can be adjusted by the gate valve. Photograph of gate valve as shown in Figure 4.4. Pressure can easily be adjusted pressure to the desire value by gate valve, which acts like a door, by controlled screw system from rotating revolving axis. It has three ports, one at the side of valve has size matched with a port of reactor chamber. Stainless steel is the material which was used to construct gate valve. Components of gate valve were demonstrated in Appendix B.

Later, Matching cage is designed. Matching network is used to adjust impedance of RF generator with the glow discharge system. Picture of matching cage is shown in Figure 5.7. It consists of a stainless cavity and an aluminum box as shown in Figure 4.5 and 4.6 respectively. Details of matching network are described in chapter 5.

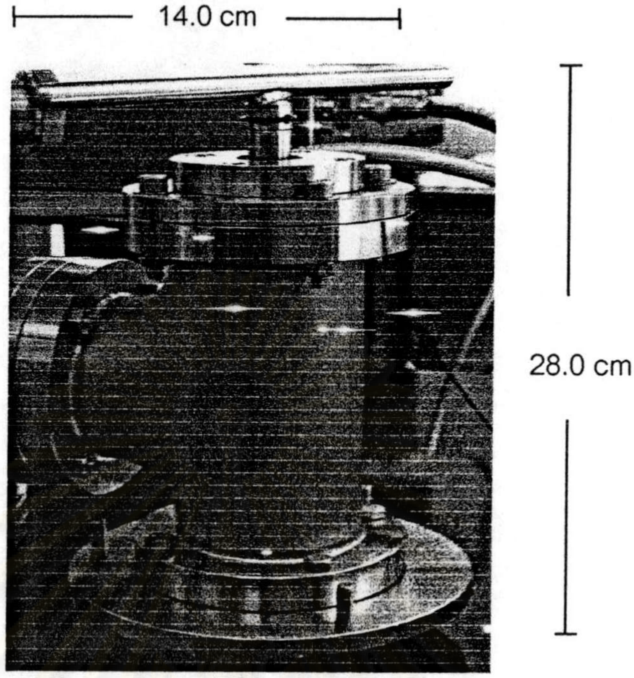


Figure 4.4: Photograph of gate valve

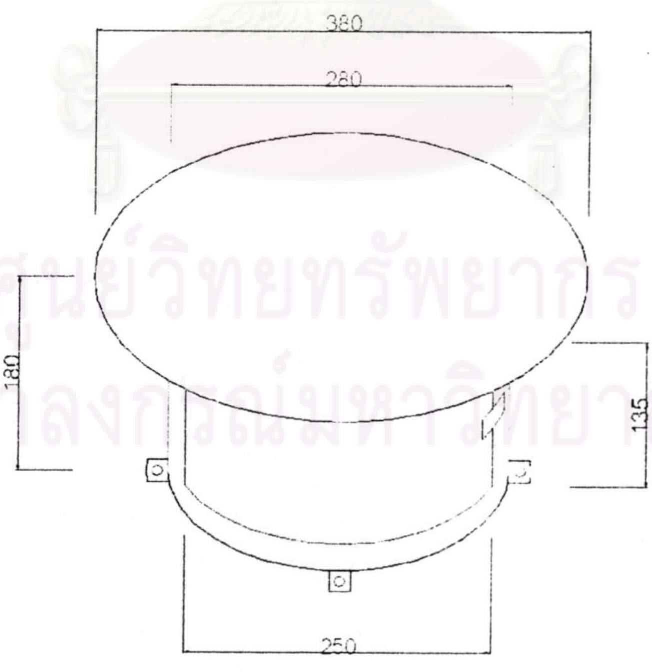


Figure 4.5: A stainless cavity

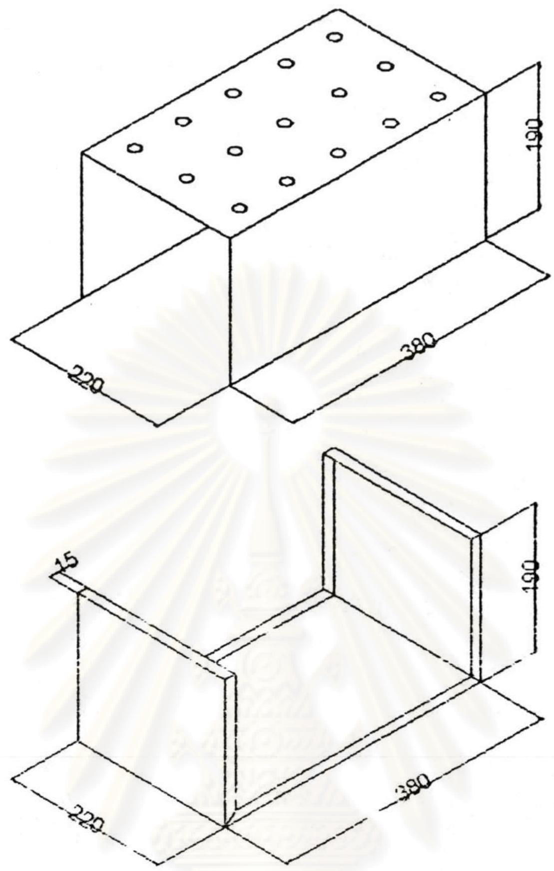


Figure 4.6: An aluminum box

4.2 System Evacuation procedure

When the built RF-PECVD is completed and is already well connected to the pumping system, a two stage rotary pump is switched on and then gate valve are open. Following by reactor chamber evacuated to the pressure of order 10^{-2} or 10^{-3} torr. Next, turbomolecular pump is switched on, it backed by a rotary pump. The pressure of the reactor chamber was reduced to about 7.0×10^{-5} torr to clean the reactor chamber and for purity of thin-film. According to the calculation, the system should be able to reduce the pressure to the ultimate pressure of 6.25×10^{-5} torr [16,17] (Details of the calculation is described in Appendix C). Test result show that the acquired ultimate pressure in the order of 10^{-5} torr is reached after 15 minute of pumping. After that, gas is introduced in to the reactor chamber and adjust the pressure to desire value. The reactor chamber and gate valve were leakage tested before film fabrication. The test results are shown below.

4.3 Vacuum results

Leak rate of reactor chamber when pump is closed is shown in Figure 4.7. The reactor is evacuated by rotary pump only.

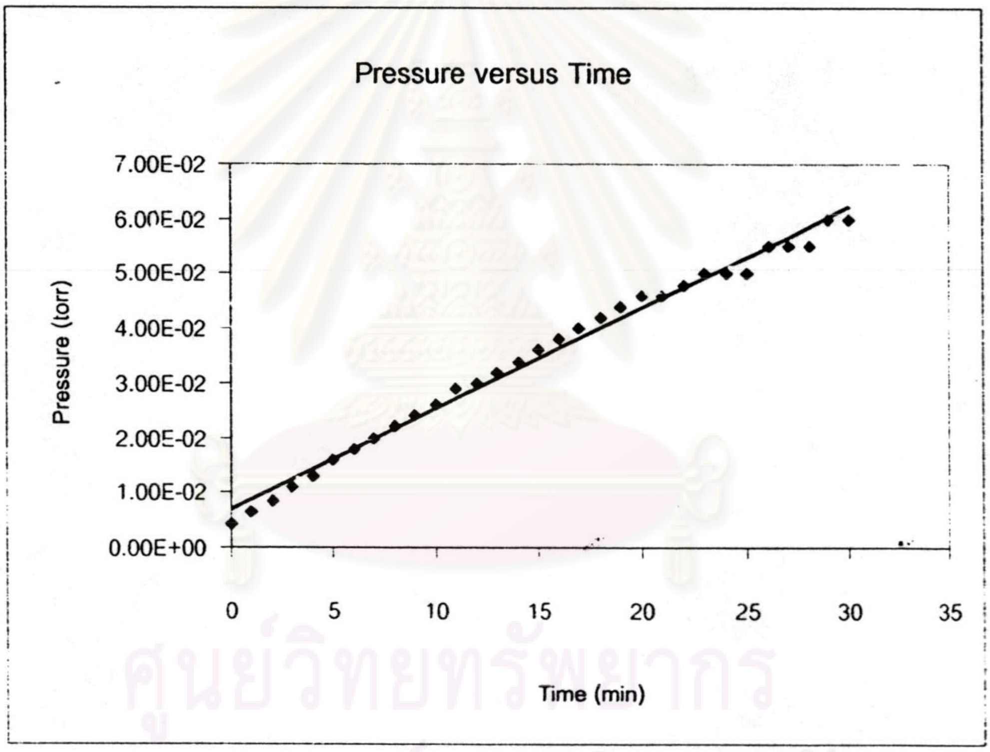


Figure 4.7: Leaking pressure of reactor chamber

Leak rate of gate valve when pumps are closed is shown in Figure 4.8. The gate valve is evacuated by a turbomoleccular pump backed by a two stage rotary pump.

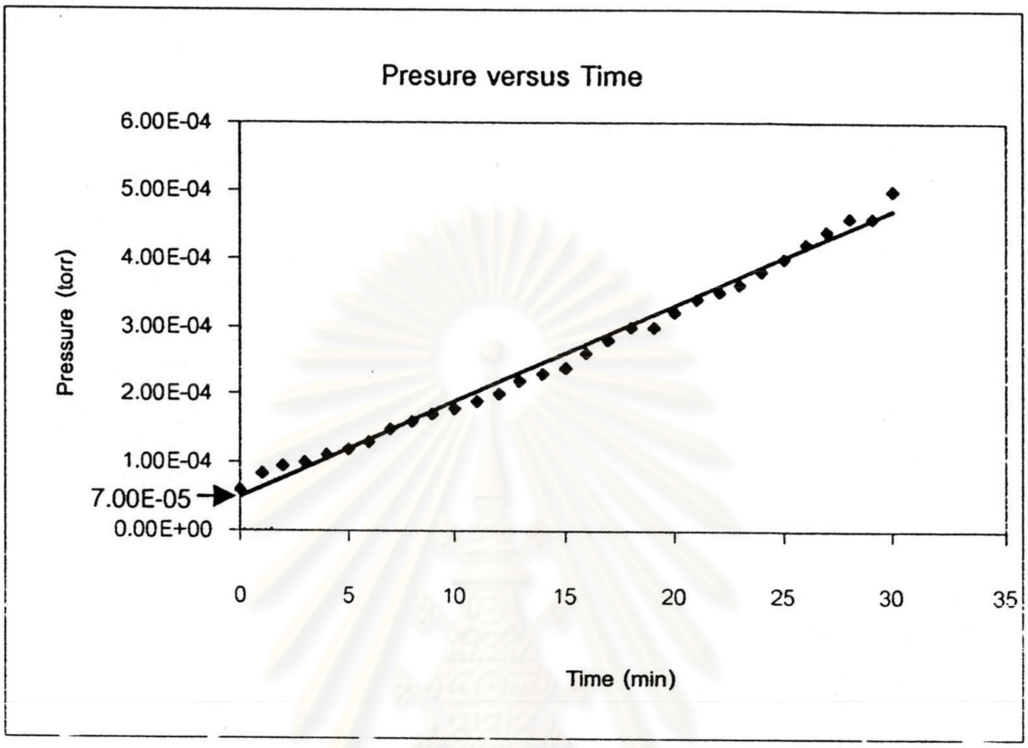


Figure 4.8: Leaking pressure of gate valve

From the linear graph in Figure 4.7 and 4.8, so that we obtain leaking of system due to outside gases through into the reactor chamber.