

# Hard Disk Manufacturing Process Monitoring

The Dycor Quadrupole Mass Spectrometer is used for process monitoring in hard drive manufacturing at leading disk drive manufacturers around the world. This application note covers the basic monitoring techniques and sampling system configurations of a Dycor Residual Gas Analyzer (RGA) used for process monitoring.

## The Seagate Deposition Process

The Dycor RGA is used to monitor the process environment before, during and after deposition of material on the hard disk surface for quality and increased yield purposes. The deposition process at Seagate Technology, one of the world's largest suppliers of disk media, uses Magnetron sputtering or RF-diode sputtering. The main sputter gas is argon. Nitrogen and helium are used as a cooling and venting gas. Each deposition chamber is separated by several buffer chambers that serve as either staging areas, cooling areas or pump-down chambers, depending on the particular process being performed.

### Horizontal Deposition System

The horizontal deposition system developed by Seagate is pictured in Fig. 1. Each disk plate will have a few thousand Angstroms of metal deposited on it during a process step. The number of disks per pallet or deposition run range from single disk plates to pallets of 56 to 104 disks at a time. The tools are capable of over 3,000 disks per hour, and are run on a 24/7 basis. The deposition process typically consists of four steps to each cycle: degas heat stage, chrome

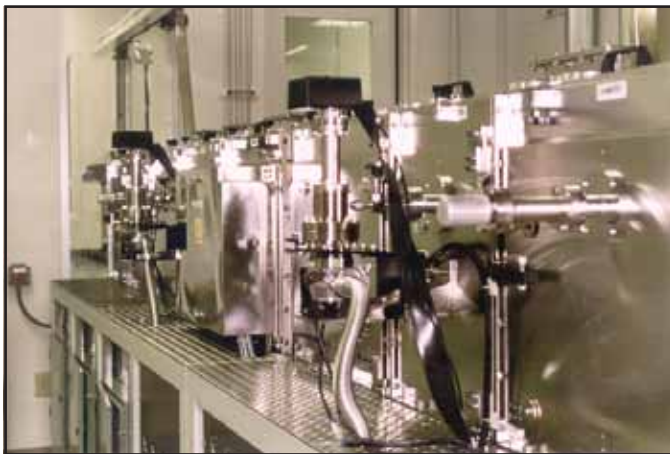


Figure 1. Seagate Technology's in-line deposition system with a Dycor RGA mounted on the chambers.

deposition, magnetic metal (CoCr) deposition, and a type of carbon overcoat process.

Seagate uses a Dycor RGA on each chamber of the deposition system (Fig. 2). In some areas of the tool, only the sensor head is installed for infrequent analysis of that area.



Figure 2. System 2000 software is used in Seagate's control room to run the RGAs.

The heat stage is a standard type of de-gas process where the pallets are exposed to a high level of heat to remove water and atmospheric gasses from the pallets to prepare the substrates for deposition. The other deposition chambers are similar to any other Physical Vapor Deposition (PVD) type chambers. A Cobalt alloy deposition is currently used as the magnetic media, and the carbon overcoat (DLC - Diamond Like Carbon) process is grown as a hard layer to protect the disk surface during operation.

### Unaxis Deposition System

Another type of hard drive deposition system, seen in the photo in Fig. 3 (over page), is the Circulus M12 deposition system made by Unaxis. Each of the 12 chambers can be seen in a circle around the center of the tool. This system is used at Western Digital, where Dycor RGAs are installed as well. Each deposition chamber has a target of the particular metal to be deposited, and a high capacity pumping system (usually a turbo pump and a high capacity water pump).

## Dycor RGA Configuration

Dycor Faraday Cup, 100 AMU heads with M240 Pressure Reduction Inlet system are used for the deposition chambers at Seagate, which are networked to the control system with a host computer and OPTOMUX control interface unit. Dycor 100 AMU RGA heads without controls are installed on the buffer chambers to perform infrequent equipment monitoring and troubleshooting tasks. These sensor heads are used with a Dycor cart system and a laptop computer.

The M240 inlet system enables the RGA to operate from a base pressure of  $10^{-10}$  Torr to a process pressure of  $10^{-3}$  Torr. All metal valves are used to avoid contamination from any elastomer and provide accurate baseline data.

Heating mantles are placed on all vacuum surfaces including the sampling inlet manifold and are baked at 200°C for at least two hours.

## Monitoring Techniques

Dycor scripts are used to customize the operation of the analyzer and data gathering to Seagate's specific requirements for the run. A common script instructs the Dycor RGA to plot trend data and save it to a file. When an "out-of-spec" limit occurs, the RGA performs an analog scan, saves the data, and then returns to process monitoring without any operator intervention. In addition, an alarm output signal from the Optomux unit is sent to the process tool. A decision can then be made as to whether or not the run should be stopped.



Figure 3. Unaxis Circulus M12 deposition system.



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