

MODULUS

THE FAMILY OF MULTILAYER SPUTTER COATING SYSTEMS
FOR ALL REWRITABLE OPTICAL DISC FORMATS

| *CD-RW*

| *DVD±RW*

| *DVD-RAM*

| *DVR*





¹³MODULUS installation at ITRI, Taiwan for research on future rewritable optical disc formats.

MODULUS Metallizer for CD-RW, DVD-RW/DVD+RW and DVD-RAM

SINGULUS TECHNOLOGIES is exclusively focused on the optical disc market and dedicated R&D leading to new proprietary technologies. In each year since its founding, SINGULUS has introduced one new and innovative product to the market. With the successful introduction of the new MODULUS multilayer metallizer for all ReWritable CD and DVD, a new generation of optical media manufacturing systems begins.

ReWritable Optical Discs

The rewritable optical discs CD-RW, DVD-RW, DVD+RW and DVD-RAM will find strong consumer acceptance in the coming years. A billion disc market is expected to open up in the coming years. Accordingly rewritable optical discs will need to be manufactured with the same productivity and ease of operation as all other CD and DVD formats. All rewritable optical discs employ phase change technology with a layer stack of 4-7 thin sputtered films. Each of these layers consists of a special material with individual requirements

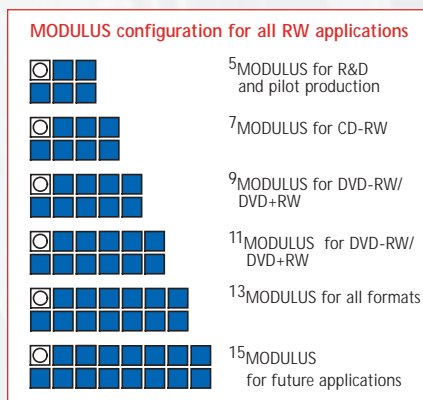
for deposition. Only when all films meet their physical specification regarding material composition, layer thickness and layer uniformity, the disc will perform according to the book specification for recording and playback. Therefore the sputter deposition of the phase change layer stack is the key manufacturing step in making a rewritable optical disc. SINGULUS TECHNOLOGIES has developed a new generation sputtering system named MODULUS for the manufacturing of phase change media.

The Concept

As of today there are not only one but several rewritable optical disc formats with different layer stacks. Number of layers, film thicknesses and uniformity requirements differ significantly.

Furthermore for each format regularly the process is refined in order to improve the recording speed particularly for data storage applications. Accordingly a key feature of a sputtering system for rewritable optical discs is FLEXIBILITY in order to handle the complexity of applications.

MODULUS is family of sputtering machines with 5-15 process stations. Each station can be equipped with a sputtering or disc cooling process module. Size and configuration of each machine will be tailored to the individual manufacturing requirements of a particular customer. The SINGULUS process team will give professional assistance in planning and realization.





Principle of SMART CATHODE:
Sputtering on Inner Diameter (A)



Principle of SMART CATHODE:
Sputtering on Outer Diameter (B)

SMART CATHODE for High Uniformity Layers

The patented SMART CATHODE is a key innovation for thin film sputter deposition from SINGULUS TECHNOLOGIES. It has been designed to combine state of the art film uniformity with cost-efficient utilization of target material. In addition the design overcomes a fundamental drawback encountered in conventional sputtering magnetrons. While usually the uniformity of the deposited film will gradually decrease, the SMART CATHODE can compensate for this effect of target erosion.

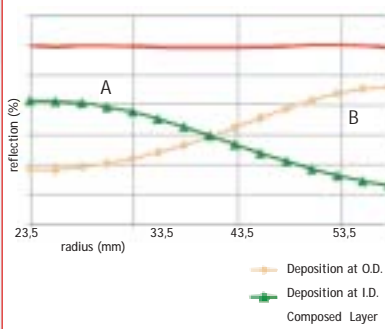
The deposition characteristics of a sputter magnetron is determined by the shape of the magnetic field. If this field is created by permanent magnets only, the magnetic field will be the same for any condition of the sputtering target and the deposition

profile will deteriorate with target age. This can not be tolerated for the rewritable optical discs. The SMART CATHODE however employs two electromagnetic coils inside the cathode housing. By running current through these coils the magnetic field can be optimized for any target condition or material composition. The SMART CATHODE sputtering process has two steps: deposition onto the inner disc area in step A and deposition onto the disc perimeter in step B. The superimposition of these two profiles results in a uniform film thickness. Due to this procedure in total 6 parameters are available for the engineer to optimize the sputtering process, which are sputtering power, sputtering time as well as the current setting for the coils for both deposition steps (2x3=6). All parameters are computer controlled and automatically matched to the target erosion situation. Switching to a new target material or changing the process conditions can be easily carried out without hardware modifications. The settings for the magnetic field deflection coils are simply changed to optimize the sputter deposition. This flexibility is most appreciated in the field of phase change technology due to the continuing need for optimizing target compositions for new generations of optical media.

Creating a Uniform Layer

- The sputtering power, time and plasma ring positions are continuously optimized to the erosion stage of the target. Accordingly, longer target lifetimes can be achieved compared to conventional magnetrons.
- By optimizing the plasma ring positions and the duration of both deposition phases A and B over the target lifetime, the uniformity and, therefore, the disc quality is much more stable than with conventional magnetrons.
- The SMART CATHODE can be easily optimized for almost any new material or composition simply by setting the coil currents for phase A and B properly.
- Due to the small target-substrate distance, very high deposition rates are achieved resulting in excellent target utilization and lower costs per disc.

Creating a uniform layer





MODULUS
THE SMART
SOLUTION!

MODULUS



¹³MODULUS installation at PIONEER, Japan, also for DVR research (Blu-ray Disc)



The Module for the DVD Generation - ¹³MODULUS

Production equipment installed today will determine the manufacturers capability for the next 5-10 years. Within this period of time many changes are expected.

■ One rewritable DVD format is likely to gain the dominant market share, as the consumer will favor a broad platform with compatible discs and recorders. Nevertheless, it is unlikely that the other formats will entirely disappear from the market. This will provide opportunities for manufacturers with the capability for handling any format.

■ Whatever format, we can expect the recording speed to increase annually just like in case of the tremendously popular CD-R. Such process refinements definitely require modification of the sputtering materials. Additional layers might be employed.

■ As of today the rewritable discs only make use of a single recording layer just like a DVD5. While technically challenging, a dual layer format seems feasible and might be introduced to the market in the future. Such a dual layer disc will require extra layers compared to the current design.

■ Finally the future will see productivity improvements particularly by reduced cycle times just like any other disc product.

A simple way of reducing the time required for the deposition processes to employ additional sputtering stations.

Whatever is going to happen, the sputtering system must have the potential to follow the market. We recommend a 13 station MODULUS sputtering system, on which our customers have realized a manufacturing cycle time of less than 5s for all existing rewritable optical disc formats. It also holds enough space for extra layers required in the future.

MODULUS Technical Data

Substrates	CD, DVD Ø120 mm (others on request)
Cycle Time	typ. <5s (format / configuration depending)
No. of Process Stations	5 - 15 (in increments of 2)
Sputter Magnetron	SMART CATHODE type
Process Modules	DC, DC reactive, RF sputtering and Cooling (all modules are fully interchangeable)
Layer Non Uniformities	<3%
Target Dimensions	Ø160 mm for DC, Ø170 mm for RF (various thicknesses) Solid or bonded on copper / molybdenum backing plates
Target Lifetime	>50.000 discs for typical configurations
Process Gases	Ar, N ₂ , He typ. total consumption 100-200 sccm
Gas Regulation	Flow Control
Masking	travelling with disc on disc receiver
Water Consumption,	typ. 150 l/min. at 18-22°C inlet temperature (process depending)
Power Consumption	400 V, 3 Phases, 50 or 60 Hz typ. 50 kW (process depending)



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