**ROTARIS**

Vacuum Deposition for Semiconductor and other Advanced R&D Applications as well as Pilot Manufacturing

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**Leading Nano-Coating Technologies**

for Magnetic Storage and Semiconductor Wafer Production

SINGULUS TECHNOLOGIES is a renowned manufacturer of advanced thin-film deposition equipment for MRAM, thin-film head, sensor and other semiconductor applications. It is the trusted partner in the respective industry and extends its leadership in the thin-film deposition technology for semiconductor applications.

SINGULUS TECHNOLOGIES introduces a universal sputter deposition machine to the market under the product name ROTARIS. The system has been designed especially for research and development in the semiconductor industry and other general applications. In order to further develop the MRAM storage technology to market maturity as well as for other semiconductor applications, many respective research institutions are in need of flexible R&D platforms such as the SINGULUS’ ROTARIS system.

With the sputter deposition system ROTARIS, SINGULUS TECHNOLOGIES is closing a gap. Pure R&D systems do not have compatibility to standard semiconductor manufacturing equipment which is needed for applied research to develop specific films, stacks of such films and material composition and to integrate them into real CMOS devices.
SINGULUS has already established and qualified the second generation of the TIMARIS PVD Cluster Tool in the market and is offering a complete portfolio of process modules for different applications. As of today, seven different process modules are available to configure a TIMARIS system according to customer needs. These modules include the Multi-Target-Module, Flexible-Target-Module, Rotating-Substrate-Module, Oxidation-Process-Module, Pre-Clean-Module, Combi-Process-Module and Static-PVD Module. Among these, the Multi-Target-Module and/or the Flexible-Target-Module are the centerpiece of the TIMARIS, whereas the Rotating-Substrate-Module is the centerpiece of the new ROTARIS platform. Most of the TIMARIS applications require the deposition of film stacks containing ultra-thin metallic and insulating layers down to a thickness of one nanometer and below with very precise material thickness and high uniformity specifications. The deposition of ferromagnetic thin films of highest quality is another unique capability of the TIMARIS.

The ROTARIS PVD system is based on the same modules, with the Rotating-Substrate-Module as the core piece of equipment and addresses the same applications considering the special needs of R&D.
**ROTARIS Universal Sputtering System**

The ROTARIS ultra-high vacuum system is a modular platform for fast, precise and fully automated thin-film sputter deposition. The ROTARIS is a bridge system for 200 mm and 300 mm wafer processing. Its main deposition chamber RSM (Rotating-Substrate-Module) can house up to 12 physical vapor deposition (PVD) cathodes with a target diameter of 100 mm.

The ROTARIS design provides in particular a rotating substrate deposition technology with the additional capability to tilt the substrate. Additional features for R&D are “Co-sputtering” with up to four cathodes, DC-, pulsed DC-, RF-sputtering, wafer heating, and an in-situ aligning magnetic field. The installation of an ion source as alternative equipment allows for surface treatment and smoothing, ion milling and side wall cleaning.

Four additional different process modules are available to configure a ROTARIS system according to customer needs to cover their challenging R&D applications. These modules include industry proven modules like the Oxidation-Process-Module (OPM), Pre-Clean-Module (PCM), Combi-Process-Module (CPM) and Static-PVD-Module (sPVD-M).

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**Rotating Substrate Technology**

1. Initial position
2. Tilting of substrate stage and selection of left set of cathodes
3. Co-sputtering by two of the left cathodes
4. Selection of right set of cathodes
5. Co-sputtering by two of the right cathodes
**ROTARIS Configurations for Different Applications**

**ROTARIS Basic**
ROTARIS Basic sputtering system for processing up to 200 mm wafer.

Example of configuration:
- 1x Rotating-Substrate-Module RSM
- Single Wafer Handler

**ROTARIS Advanced**
ROTARIS Advanced sputtering system with additional modules for processing up to 200 mm wafer.

Example of configuration:
- 1 x Rotating-Substrate-Module RSM
- 1 x Combi-Process-Module CMP
- Vacuum Transport Module

**ROTARIS Diversity**
ROTARIS Diversity sputtering system with six modules for advanced processing up to 200 mm wafer.

Example of configuration:
- 3 x Rotating-Substrate-Module RSM
- 1 x Combi-Process-Module CMP
- 1 x Small-Thermal-Process-Module sTPM
- Vacuum Transport Module

**More modules:**
- Oxidation-/Combi-Process-Module (OPM/CPM)
- Pre-Clean-Module (PCM)
- Static-PVD-Module (sPVD-M)
Applications & Features

- Rotating substrate deposition
- 200 mm and 300 mm wafer
- Up to 12 PVD cathodes, target Ø 100 mm
- Co-sputtering
- DC/RF sputtering
- Base pressure < 10⁻⁸ Torr
- Hot wafer deposition
- Options
  - ICP ion source
  - In-situ aligning magnetic field

Configuration with ion source and ten cathodes. Only left or right located process equipment can be operated at the same time.
Basic configuration with 12 cathodes. Only left or right located process equipment can be operated at the same time.

Co-Sputtering

Left: Four outer cathodes selected
Right: Two inner cathodes selected

RF-Sputtering

Left: Four Cathodes on each side are selectable for RF sputtering
Right: Four Cathodes on each side are selectable for RF sputtering

Process chamber with two different sputtering variations:
1. Four left hand cathodes or open shutters for DC-CO-Sputtering
2. Two right hand cathodes for CO-sputtering
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SINGULUS TECHNOLOGIES – Innovations for New Technologies
SINGULUS TECHNOLOGIES develops and assembles innovative machines and systems for efficient and resource-saving production processes, which are used worldwide in the solar, semiconductor, medical technology, consumer goods and data storage.

The company’s core competencies include various processes of coating technology, surface treatment and wet-chemical and thermal production processes.