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FRAUNHOFER INSTITUTE FOR ORGANIC ELECTRONICS, ELECTRON BEAM AND PLASMA TECHNOLOGY FEP

DOUBLE RING MAGNETRON – DRM 400

SPUTTERING FOR STATIONARY COATING

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Double Ring Magnetron – DRM 400

High-precision coatings are required for a wide range of applications in the area of optics, electronics and sensor technology, solar energy and bio-medical technology.

Stationary magnetron sputtering processes being long-time stable allow the deposition of high-precision, homogeneous and reproducible layers at efficient rates.

At Fraunhofer FEP we have developed a coating system based on the Double Ring Magnetron DRM 400 that can be integrated in Cluster-type plants and that can prospectively be scaled up to multi-ring magnetron sources.

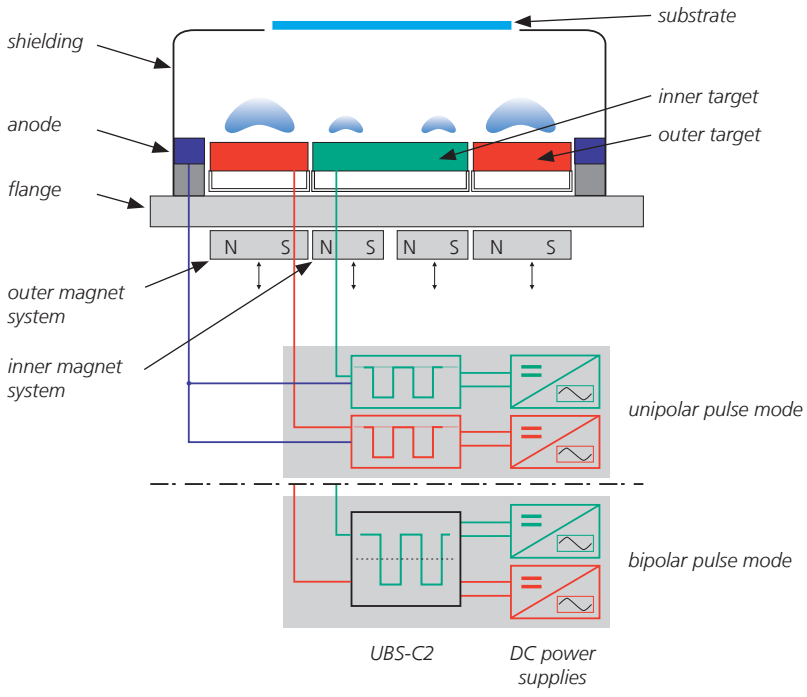
Individually controllable concentric plasma discharges from the inner and outer ring systems allow layer thickness homogeneities of up to ± 0.5 percent (for substrate sizes of 8" /200 mm) to be achieved.

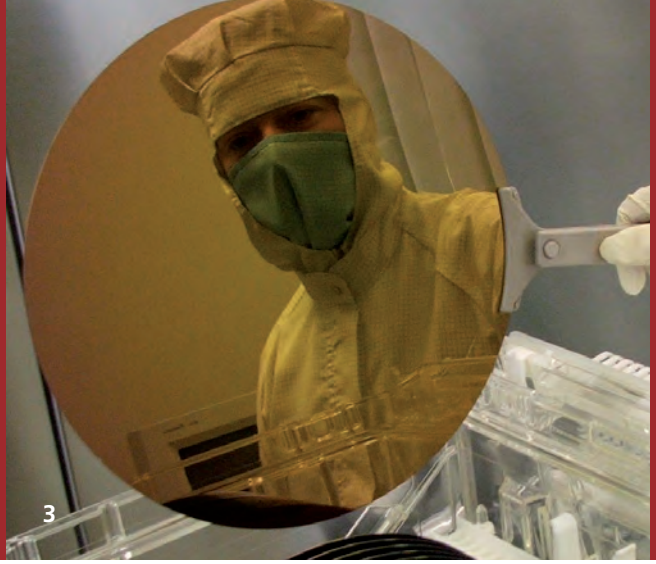
Innovative control concepts are also opening new processing options such as the deposition of gradient layers by changing the composition of the reactive gas during the coating process.

Hardware

- DRM sputter source with integrated
  - gas distribution system
  - electrically insulated inner and outer targets
  - individually adjustable magnet systems
  - long-term efficient hidden anode
  - reactive gas control valve
  - optical emission detector (OED)
- DC, MF pulse or RF powering according to application
- MF powering in different pulse modes (unipolar, bipolar or pulse package) for adjustment of energetic substrate bombardment
- measurement and control devices for
  - inert and reactive gas flow
  - process pressure
  - optical plasma emission
  - magnetic field strength at target surface
- process management computer
- RF bias, RF ion etching capabilities available

Scheme of DRM-type magnetron sputter sources





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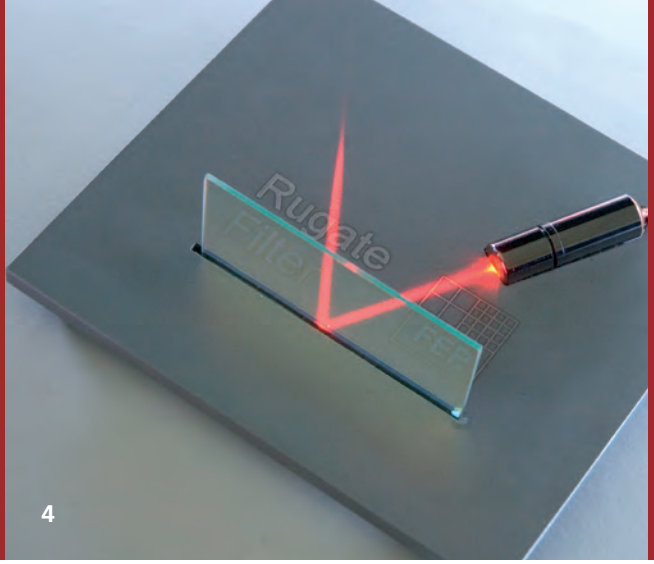

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Process control and technology

- automatic push button control of the entire coating procedure
  - stabilization of reactive process for high-rate and long term stable processing
  - magnet adjustment to compensate target erosion
  - control of power input
  - gas inlet management and pressure control
- variation of reactive gas composition during deposition
- pre-programmed recipes for a variety of coating applications
- communication to host computer for fully automatic run of the sputter system
- remote control via telephone for support, service and software upgrade

TITLE PHOTO

View of DRM 400 from target side

1 *DRM 400 on cluster plant*
2 *Integrated package with DRM 400*
3 *Functional coating on 300 mm wafer*
4 *Rugate filter*

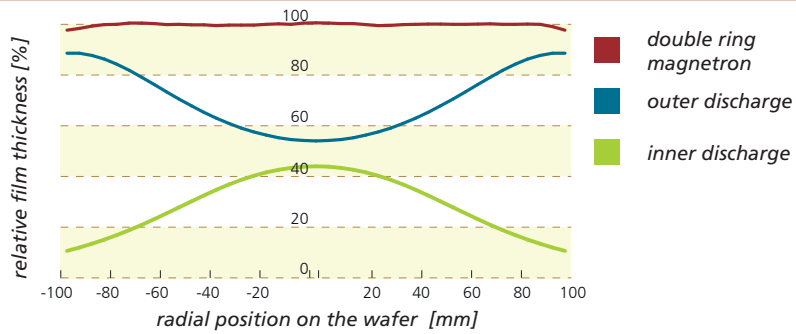
Our offer

- application-oriented process development of layer systems with customer specific requirements
- feasibility studies
- technology packages with process development and key components
- technology transfer
- retrofit of coating equipment

Applications

- optical coatings
- piezoelectric layers
- electrical insulation films
- passivation, protection and barrier layers

Superposition of film thickness contributions from inner and outer discharge ring



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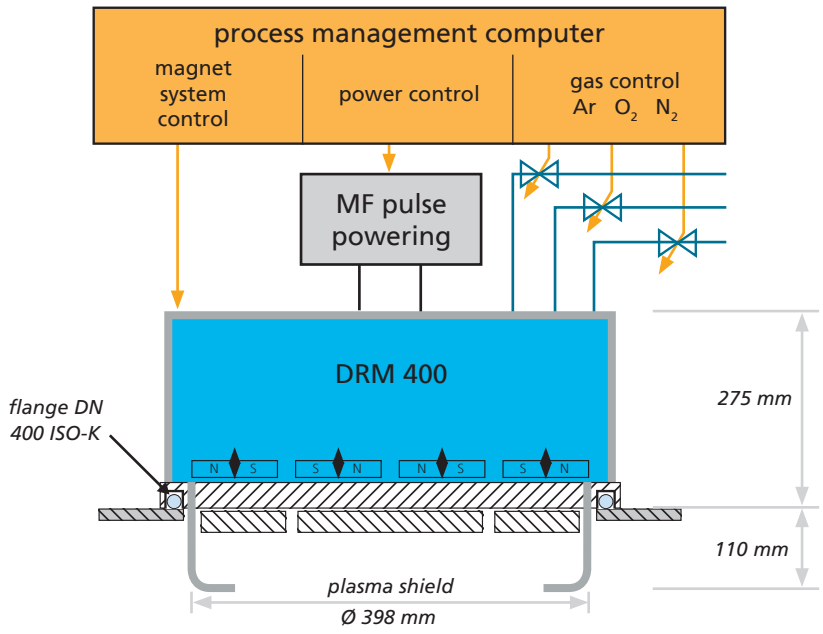
DRM 400 – Typical layer materials

type of layer	examples	deposition rate [nm/s]
metals	Al, Cr, Cu, …	15 ... 25
alloys	Ni/Al, NiV_7, …	10 ... 15
binary compounds	Al_2O_3, AlN, AlF_3, SiO_2, Si_3N_4, TiO_2, Ta_2O_5, Nb_2O_5, TaN, HfO_2 ….	2 ... 4
ternary compounds	$Si_XO_YN_Z$, $Al_XO_YN_Z$, $Si_XTa_YO_Z$, $Al_XSi_YO_Z$, $Al_XSc_YN_Z$	2 ... 4
gradient layer system	$SiO_2 \rightarrow Si_XO_YN_Z \rightarrow Si_3N_4$ $Al_2O_3 \rightarrow Al_XO_YN_Z \rightarrow AlN$ $SiO_2 \rightarrow Si_XTa_YO_Z \rightarrow Ta_2O_5$	2 ... 4
hybrid compounds	$Si_XC_PO_Q$, $Si_XC_PO_YN_R$, $Si_XTi_YC_PO_Q$, $Si_XC_PO_QH_R$	5 ... 15

Different target materials for the inner and outer targets enable the deposition of alloys and multilayers. With reactive pulse sputtering the depositon of compound layers can be achieved.

Integrated package with DRM 400



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