# PL11

## Reactive Dual Magnetron Sputtering for Large Area Application

Johannes Strümpfel

VON ARDENNE ANLAGENTECHNIK GMBH,
Plattleite 19/29, D-01324 Dresden, Germany,
e-mail: struempfel.johannes@ardenne-at.de

Production lines for large area coating demand high productivity of reactive magnetron sputtering processes. Increased dynamic deposition rates for oxides and nitrides were already obtained by using of highly powered magnetrons in combination with advanced sputter techniques. However, besides high deposition rates the uniformity of such coatings has to be carefully considered.
First the basics of reactive sputtering processes and Dual Magnetron sputtering are summarized.
Different methods for process stabilization and control are commonly used for reactive sputtering. The Plasma Emission Monitor (PEM) offers the prerequisite for fast acting process control derived from the in-situ intensity measurements of a spectral line of the sputtered target material. Combined by multiple Plasma Emission Monitor control loops segmented gas manifolds are able to provide excellent thin film uniformity at high deposition rates.
The Dual Magnetron allows a broad range of processing by different power supply modes. Medium frequency, DC and pulsed DC power supplies can be used for high quality layers.
Whereas the large area coating of highly isolating layers like $TiO_2$ or $SiO_2$ is dominated by MF sputtering best results for coating with transparent conductive oxides are obtained by dual DC powering of the Dual Magnetron arrangement.
As an example acts the substantially enhanced $TiO_2$ coating by using 3 channel PEM control of the oxygen gas inlet nearby the MF sputtered Dual Magnetron cathode in production plants. The gas inlet is individually controlled for the different sections of the Dual Magnetron length. For such application the response time constant and the features of the reactive gas manifold have to be carefully optimized.
In the case of deposition of low refractive index $SiO_2$ films the same type of proportionally and integrated acting PI controllers can be simultaneously used for both impedance control and balanced intensity control (IMBAL) versus cathode length.
A comparison of ITO and ZAO Dual Magnetron processing in DC/DC and MF mode will be presented. The result shows better resistivities in DC mode The property distribution versus magnetron width of both resistivity and transmittance for magnetrons powered in different modes are compared. Process parameters for good resistivities at high dynamic deposition rates will be summarized.
Examples for coating plants using such advanced reactive Dual Magnetron sputtering techniques for architectural, display and photovoltaic applications will be presented.