GRS

Gencoa Rotatable System

GENCOA

High target use and lower coating defects are among the benefits of replacing a rectangular planar with Gencoa's new small-size rotatable magnetron.

A new sputtering development at Gencoa is expanding the market for rotatable magnetrons. The new design concept allows target diameters down to 75mm to be accommodated, and the compact nature of the end-block at just over 50mm (2") wide means it can readily replace planar magnetrons.

The Gencoa Rotatable System is here to allow rotating magnetron benefits for any thin film environment. The small physical footprint combined with the flexibility of target sizes open up the use of rotatable technology from small scale R&D to high speed display production.

Old is new!

The use of rotatable sputter magnetrons has been gathering pace for nearly 30 years. The first patent of this concept appears to date back to 1981 and Shatterproof Glass of America (US 4356073 A). The journey was relatively slow in the early times but since 2005 the pace has increased as the initial patent protect started to expire and product designs matured and became more reliable. The combination of power delivery and dynamic sealing of the cooling water has always been a challenge for the vacuum environment and led to a slow initial adoption. The main application historically was for the large area glass arena, where the extended lifetime of the targets and the reduction of 'dust' on the glass in the sputter-down arrangement is a huge advantage over planar magnetrons. Rotatable magnetrons are now the predominant sputter device for all architectural glass production: and as a result, the development of rotatable magnetrons has focussed on this market (i.e. the ability to handle up to 3.8m long target tubes and with targets that can run for 4-6 weeks of continuous production before target change).

The industry standard size of target tube is nominally a 150mm (6") outside diameter. This presumably was a good estimate of the most appropriate size in the early 80's when the concept was devised. This size of target is a good choice for the large area glass market as it yields long coating campaigns, economy of scale and less frequent interruptions for servicing.

Until the start of the boom of the thin film solar sector from 2005, the use of rotatable magnetrons outside large area glass coating was very rare. The solar boom lead very quickly to a rush for lowest production costs and minimum projected cell prices, so the extended target life and better target use from rotatables was a good choice and was widely adopted. Although the solar market has suffered a big set-back, the introduction of rotatables to that sector can be classed as a success, even though the choice of planar or rotatable magnetrons does not seem to have had much bearing on the success or failure of the specific venture. From our customer base there are as many 'going-concerns' in the solar sector using planar magnetrons as rotatables.

The rest of the sputtering world is now waking up to the option of rotatable magnetrons. This is a big opportunity as there are many planar magnetron based coating systems manufacturing consumer products from cell phones to OLED displays. The question is whether the devices used in the architectural glass sector are appropriate for these other sectors and more importantly whether they can actually fit into existing machines.

To answer these questions, the Gencoa Rotatable System (GRS) has been developed.

Normally when specifying a planar based magnetron sputter machine the choice of the most appropriate target width is the first consideration. Target width partly determines the length of the target required and the uptime of the target – via the target material volume available (see http://www.gencoa.com/download/coating_uniformity_issues.pdf for more information).

Likewise, for rotatable magnetrons the first question should be what the most appropriate target diameter is. This has a large bearing on the ultimate machine design and process costs. The GRS has the standard options of a 75, 90 or 100mm outside diameter; much like the choice for planar magnetrons. The effect of changing the OD and thickness of the target can be calculated in terms of target life on the Gencoa rate calculator tool, to yield the estimated up-time for the process. (http://www.gencoa.com/sputtercalc/) The choice of target diameter is partly what's most appropriate for the process and what is readily available in terms of target materials. For example a cold isostatically pressed ITO target is available with a 90mm OD size, whereas sprayed ITO can be produced in other OD sizes. Metal targets are typically available in tube form or can be extruded to a certain size. Sprayed targets are usually more flexible in terms of OD.

Flexibility, fit and cost

The GRS concept has all the advantages of rotatable technology with a lower cost and space impact. The advantages include:

• High target use: 70-90% depending upon magnetics and target design / thickness.
• Lower coating defects from a clean target surface.
• Hi power capacity, typically up to 60 kW per end-block.
• Small space; a dual two target GRS can fit into a typical space for a single 5-6" planar magnetron.

Applications

Here are some examples where the GRS can provide an immediate impact on costs and process improvements:

Rapid metallizing - for light reflectors, EMC shieldings, cosmetics, cutlery

Although these applications require a simple metal layer on plastic, it comes with competitive challenges. The finished product is low cost and mass produced with strong competition from even lower-tech evaporation processes. The key is to cycle the parts through quickly and use the resources efficiently. A GRS will run at 2-3 times the power of a planar magnetron and double the number of magnetrons can be located in the same space. Hence the production capacity of a given machine can be 4-6 times higher for the PVD stage with GRS. As an example, a 10mm thick 100mm OD target will have 2.5 times the uptime compared to a 125mm wide planar target with 16mm thickness.

Oxides - for solar control glazing, touch screens / film, OLED gas barriers

Double rotatable magnetrons are the undisputed 'king' of reactive sputtering! The clean target surface ensures smooth processes with minimal arcing and defects. As the electrons switch from one target to the next, the neighbouring target surface has a uniform electrical state - no re-deposit as with planars. A double GRS can slot into a single planar port to convert an RF or single cathode oxide processes to a high rate reactive process with low defects and long target life. The typical deposition rates of a feedback controlled GRS reactive process is over10 times faster than RF sputtering and over 5 times faster than a single cathode non-feedback process.

ITO - for touchscreens, CIGS solar cells, OLEDs

Layers of Indium Tin Oxide (ITO) are in both high demand and present multiple problems during processing. The problems are high indium costs and low target use, low power capacity due to target cracking, and nodule formation on the target leading to process drift which requires frequent process interruption for cleaning off the nodules. The GRS will typically use x3 more of the available target material compared to a planar magnetron giving a much longer between changeover. The nodules can be avoided due to the good target cleanliness. Typically power would not be increased greatly as it increases the voltage of the target which is not desirable for ITO film properties. The GRS would typically use a high strength magnetic array for ITO to minimize the target voltage, and an addition active anode further improves the ITO properties.

Additional configuration options

The GRS flexibility does not stop with target size only. The product is available as a 'drop-in' or 'side-mount' in single or double configurations, and with targets up to 2m (70") in length. There are different magnetic options and accessories available to allow switching between different plasma process types:

• DC, DC pulsed and AC sputtering
• Hipims sputtering
• RF & RF/DC sputtering
• PACVD
• ARC evaporation (with integrated power supply – 2015)

For further information on the GRS, visit **http://www.gencoa.com/grs** or email **sales@gencoa.com**.