Gencoa FFE300

Uniformity adjustment during wafer metalizing

GENCOA

Through various techniques, Gencoa's 12" circular full face erosion magnetron provides end-users with the flexibility to tune uniformity.

The use of 'clean' target sputtering offers many benefits for layer creation. For the last 30 years of PVD coating, the semiconductor industry has favoured the use of circular planar magnetrons where a magnet array is rotated, improving both film uniformity and target utilization. As mentioned in December 2013's technical paper Gencoa has developed full face erosion (FFE) magnetrons with target diameters starting from 75mm and currently up to 300mm.

Highlighted in this technical paper is the FFE300 (12" target) magnetron which offers the ultimate in uniformity control on wafers of up to 200mm diameter at low target-to-substrate separations – typically 50-70mm. This low target-to-substrate separation ensures a high rate of transfer of material from the target to the substrate for rapid wafer metallizing.

Gencoa's FFE300 is designed to provide a uniformity of <± 3% over 200mm diameter wafers with the ability to adjust to <±1% by using the in-built modes of tuning.

One key element of the design is that the rotating magnetic array is

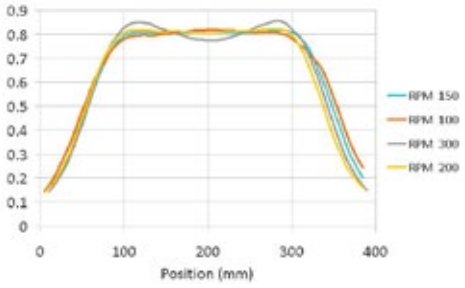


Figure 1: Effect of rotation speed on layer thickness

located in atmosphere to avoid the usual problems with water contact.

This also allows the rotational speed of the array to be over a much larger range than would normally be employed. This flexibility in the rotational speed is a key aspect in the uniformity tuning of the deposited layer thickness.

The different modes of tuning for the FFE300

When using FFE300 magnetron, three different methods can be applied in order to tune the uniformity.

1. Adjustment of the rotational speed of the magnetic pack.

This is the most powerful element of FFE designs with target sizes of 10" and above. It enables extremely accurate tuning of the layer uniformity to a fraction of a percent, and can be used to dynamically correct for target erosion (see figure 1).

The ability to tune uniformity through speed variation removes the need for different magnet packs for different materials. For different target material types, it is generally only required to vary the rotational speed to optimize the uniformity. As the speed of rotation increases the plasma is 'driven' closer to the outer edge of the target which results in an increase of material deposition at the outer edge of the wafer. This speed profile can be further adjusted as the target erodes to hold the uniformity at the initial values.

There is a further, even finer layer thickness tuning ability via a dynamic speed profile during the deposition time. This speed ramp during sputtering can be used to further reduce layer thickness variations below the ±1% range.

The speed adjustment is typically 10-400rpm via the drive mechanism and can be set locally or remotely using the tool's main machine interface. The choice of motor can be made based the customer's preference, or supplied and fitted by the customer.

Figure 2: Adjusting the location of the magnetic pack can be easily carried out, and without dismounting the magnetron

2. Varying the location of the magnetic pack.

Design of the 12" FFE allows customer to vary the position of the magnetic pack relative to the central axis of rotation to fine-tune uniformity.

This can be done by a lead screw adjustment on the back of the magnetic pack without dismounting the magnetron from the chamber.

In-house testing has proved that by moving the array by 2mm, the uniformity measurement over 200mm changed by ±1.68%. The position of the magnetic pack is only changed if the speed adjustment does not provide sufficient tuning. As delivered the FFE300 will be set-up to deliver <±2% uniformity for most materials and processes. But if processes run at extremes of power or pressure, then this extra adjustment can be required.

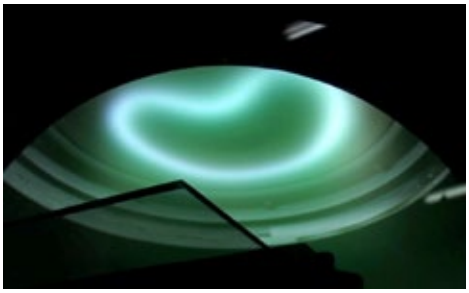
3. Local adjustments to the magnetic pack using pre-configured shunts.

This method requires the lifting of the magnetic pack from the source, and positioning of the shunts. This should only be done by following the advice of Gencoa as to where the shunts should be placed. Generally this should not be necessary and the source can be pre-configured at Gencoa if the target material is provided before shipment. But if the source is running ferromagnetic target materials of various compositions, there is a strong influence on the rotating plasma, and this means of adjustment could be applied. For ferromagnetic targets a special higher strength magnet pack is utilized.

The FFE300 source is mounted on a DN420LF flange as standard or adapted to OEM port or machine designs. This technology can also be integrated to existing tools with further design changes in order to upgrade the process capabilities.

Whilst uniformity can be improved the benefit of a 'clean' target surface will reduce defects during processing.

Generally the FFE300 standard cathode design is held in stock for a quicker lead-time. A pre-delivery test and tuning service is available for non-standard process situations.



A video of the FFE300 in operation can be viewed on the Gencoa website: http://www.gencoa.com/12-inch-circular-ffe

For further product information, email **sales@gencoa.com**.