The Economics of Rotary Cathodes

Summary

Rotary cathodes offer many advantages over planar cathodes including reduced particle generation, increased uptime due to elimination of burn-in, and the ability to run insulating materials at much higher power densities than their planar counterparts.

These advantage, while significant, may not be compelling enough to those concerned with the higher capital cost of rotary cathodes. However, one of the simplest ways to justify the rotary cathode is through increased material utilization. This type of analysis demonstrates from 30% to 80% savings in ongoing material cost by using rotary cathodes.

Our Analysis

In this example, we will look at the case of comparable chromium targets in planar and rotary form.

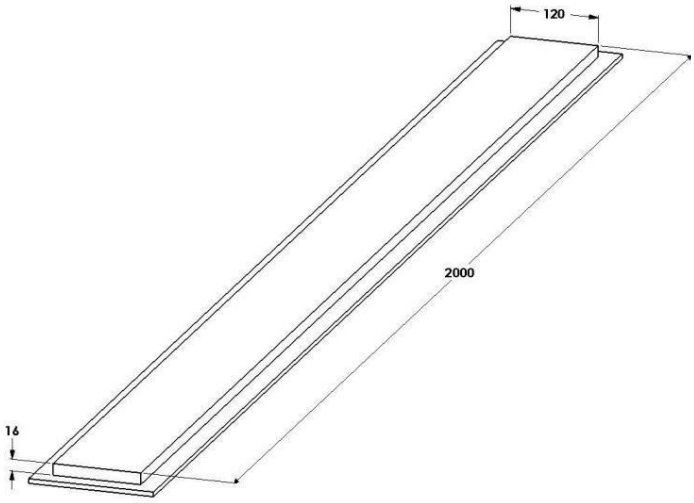

Figure1: Planar Target

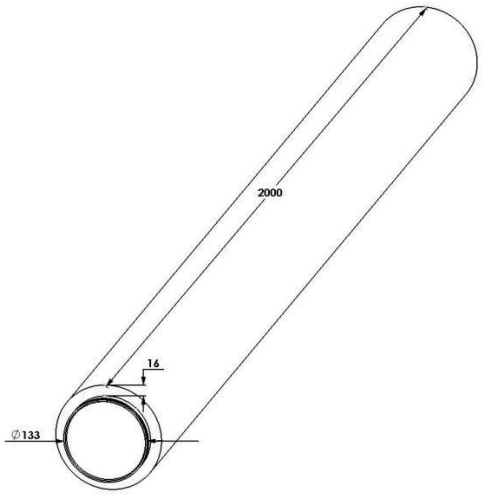

Figure 2: Rotary Target

Figure 1 represents a planar chromium target on a copper backing plate with dimensions 120 mm wide by 2000 mm long by 16 mm thick. Figure 2 represents a rotary chromium target using a stainless steel backing tube of 133 mm outer diameter, 2000 mm long and with a 16 mm overlay of chromium. In the analysis, the chromium is applied by a plasma spray process. Table 1 shows the variables used in the analysis and the results.

Parameter	Planar	Rotary
Material thickness	16 mm	16 mm
Width	120 mm	162 mm (with a 133 mm OD backing tube)
Length	2000 mm	2000 mm

Material volume	3,840,000 mm^3	14,979,101 mm^3
Material mass	27,648 g	97,364 g
Material density	0.0072 g/m^3	0.0065 g/m^3
Material utilization	0.35	0.80
Utilized volume	1,344,000 mm^3	11,983,281 mm^3
Utilized mass	9677 g	77,891 g

Target Price	$6,300	$25,000

Price/gram used	$0.65	$0.32

Table 1: Material cost calculation results, chromium

Payback Analysis

In this example, ongoing material cost is roughly halved by using rotary targets. Let us assume that a rotary cathode in 2-meter size lists for $45,000 and a planar cathode in 2-meter size lists for $22,500, half the price[1]. In our definition, the rotary cathode consists of the drive portion (or end block), the magnetics and any necessary outboard support.

Let us also assume that our factory uses eight planar chrome targets per month at a cost of just over $50,000. To achieve the same result, the same factory would need only one rotary target per month at a cost of $25,000. The actual payback period depends on the number of process slots (or cathodes) in use, but let us say that there will be four cathodes in operation at the factory in this example.

For a new system using four cathodes at a 2-meter length, the incremental capital cost of the rotary cathodes over the planar cathodes would be $90,000, but the factory would see $25,000 per month in material cost savings. This represents less than a 4-month payback.

If the factory is already using planar cathodes that must be replaced, the analysis results in a longer, but still acceptable, payback estimate of 8 months.

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[1] Planar cathodes scale in capital cost linearly with machine size. Rotary cathodes have a much lower dependence on machine size; therefore for very large systems, the price of rotary cathodes can be virtually the same as planar cathodes. In a 4-meter-wide system, the planar cathode would double in price to approximately $45,000 while the rotary would increase only 10% to about $50,000.

Factors Influencing Payback

- In general, the more expensive the material, the better the payback from rotary cathodes. Some additional sample material cost calculation results are included in the Appendix.
- Utilization rates can vary, and this does affect payback. Planar utilizations range from 25% to 45%, while rotary utilizations can range from 70% to as high as 95%.

Conclusion

Though initially more expensive than planar cathodes, rotary cathodes can exhibit demonstrable savings in material cost over time. In many cases, payback periods can be as short as a few months.

For more information about the benefits of SCI rotary cathodes, please contact us at sales@sputteringcomponents.com.

APPENDIX

Additional materials of Interest

AZO - Ceramic		
Parameter	**Planar**	**Rotary**
Material thickness	16 mm	16 mm
Width	120 mm	162 mm (with a 133 mm OD backing tube)
Length	2000 mm	2000 mm

Material volume	3,840,000 mm^3	14,979,101 mm^3
Material mass	20,736 g	80,887 g
Material density	0.0054 g/m^2	
Material utilization	0.35	0.80
Utilized volume	1,344,000 mm^3	11,983,281 mm^3
Utilized mass	7258 g	64,710 g

Target Price	$7,800	$23,000

Price/gram used	$1.07	$0.36

Silicon		
Parameter	**Planar**	**Rotary**
Material thickness	6 mm	7.5 mm
Width	160 mm	148 mm (with a 133 mm OD backing tube)
Length	1500 mm	1500 mm

Material volume	1,440,000 mm^3	4,963,162.5 mm^3
Material mass		
Material density		
Material utilization	0.35	0.80
Utilized volume	504,000 mm^3	3,972,541 mm^3
Utilized mass		

Target Price	$3,300	$8,500

Price/mm^3 used	$0.0065	$0.0021

GZO - Ceramic		
Parameter	**Planar**	**Rotary**
Material thickness	16 mm	9.25 mm
Width	200 mm	152 mm (with a 133.5 mm OD backing tube)
Length	1650 mm	1650 mm

Material volume	5,280,000 mm^3	69,844,651 mm^3
Material mass		
Material density		
Material utilization	0.35	0.80
Utilized volume	1,848,000 mm^3	5,475,721 mm^3
Utilized mass		

Target Price	$13,000	$22,000

Price/mm^3 used	$0.0070	$0.0040