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. One of the simplest ways to justify the rotary cathode is via increased material utilization. By using this type of analysis, one can demonstrate 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.

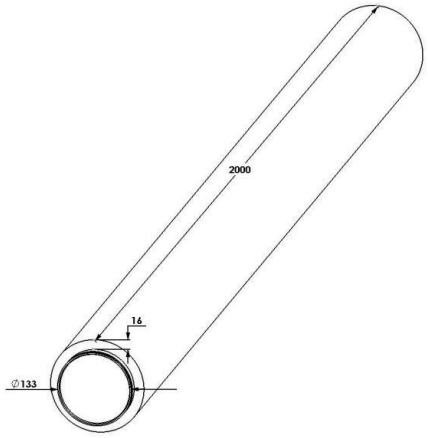

Figure1 – Planar Target

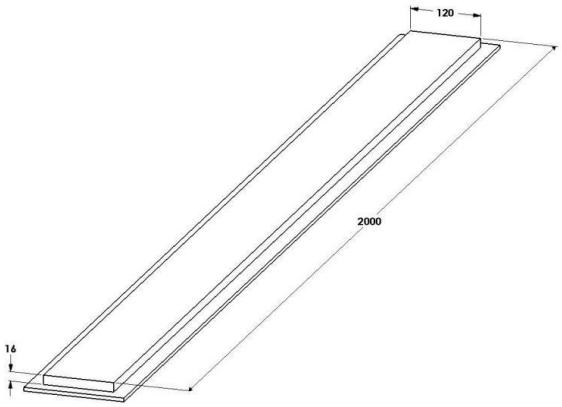

Figure 2 – Rotary Target

Figure 1 shows a planar chromium target on a copper backing plate with dimensions 120mm wide by 2000mm long by 16mm thick. Figure 2 shows a rotary chromium target using a stainless steel backing tube of 133mm outer diameter, 2000mm long., with a 16mm 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:

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Parameter	Planar	Units	Rotary	Parameter
Material thickness	16	mm	16	Material thickness
Width	120	mm	133	OD (Backing tube)
Length	2000	mm	2000	Length
Material volume	3840000	mm^3	14971520	Material volume
Material mass	27684	g	97315	Material mass
Material density	0.0072	g/mm^3	0.0065	Material density
Material utilization	0.35		0.80	Material utilization
Utilized volume	1344000	mm^3	11977216	Utilized volume
Utilized mass	9689	g	77852	Utilized mass
Target Price	$6,300		$25,000	Target Price
Price/gram used	$0.65		$0.32	Price/gram used

Table 1: Material Cost Calculation Results

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; roughly 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 8 planar chrome targets per month at a cost of just over $50,000. To achieve the same result, the same factory would need only 1 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 4 cathodes in operation at the factory in this example.

For a new system using 4 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.

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Factors Influencing Payback

1. In general, the more expensive the material, the better the payback from rotary cathodes. Some additional sample material cost calculation results are included in Appendix A.
2. 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.

If you need further information about the benefits of SCI rotary cathodes, please contact us at sales@sputteringcomponents.com

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APPENDIX A

Additional Materials of Interest

AZO – Ceramic				
Parameter	**Planar**	**Units**	**Rotary**	**Parameter**
Material thickness	16	mm	16	Material thickness
Width	120	mm	133	OD (backing tube)
Length	2000	mm	2000	Length
Material volume	3840000	mm3	14971520	Material volume
Material mass	20736	g	80846	Material mass
Material density	0.0054	g/mm3	0.0054	Material density
Material Utilization	0.35		0.80	Material utilization
Utilized volume	1344000	mm3	11977216	Utilized volume
Utilized mass	7258	g	64677	Utilized mass
Target price	$7,800		$23,000	Target price
Price/gram used	$1.07		$0.36	Price/gram used

Silicon				
Parameter	**Planar**	**Units**	**Rotary**	**Parameter**
Material thickness	6	mm	7.5	Material thickness
Width	160	mm	133	OD (backing tube)
Length	1500	mm	1500	Length
Material volume	1440000	mm3	4963162.5	Material volume
Material mass		g		Material mass
Material density		g/mm3		Material density
Material Utilization	0.35		0.80	Material utilization
Utilized volume	504000	mm3	3970530	Utilized volume
Utilized mass		g		Utilized mass
Target price	$3,300		$8,500	Target price
Price/mm3 used	$0.0065		$0.0021	Price/mm3 used

GZO - Ceramic				
Parameter	**Planar**	**Units**	**Rotary**	**Parameter**
Material thickness	16	mm	9.25	Material thickness
Width	200	mm	135.5	OD (backing tube)
Length	1650	mm	1650	Length
Material volume	5280000	mm3	6937035.2	Material volume
Material mass		g		Material mass
Material density		g/mm3		Material density
Material Utilization	0.35		0.80	Material utilization
Utilized volume	1848000	mm3	5549628	Utilized volume
Utilized mass		g		Utilized mass
Target price	$13,000		$22,000	Target price
Price/mm3 used	$0.0070		$0.0040	Price/mm3 used

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