

Preliminary Specifications for LMCP Substrate and Functional Coatings

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Substrate Considerations

The LMCP design is amenable to nearly any type of dielectric substrate, including, but not limited to: Glass, Ceramics, Polymers, ... The basic requirements are that the material is easily patterned (additive, subtractive, direct write, lithographic, ...), does not require specialty equipment for manufacture or assembly and is inexpensive in volume.

Laminae Physical Dimensions	Specification
Length (L)	100mm
Width (W)	2.4mm
Thickness (τ)	$3\alpha = 0.120\text{mm}$
L:D	60:1
Flatness	+/- 0.008 mm
Pitch (P)	2α
Pore Pitch uniformity	<5%
Pore Size (α)	0.040 mm
Pore Size uniformity	<5%
Bias Angle (φ)	$15^\circ \pm 1^\circ$
Open area ratio	TBD
Overlay tolerance	0.1α

Functionalization

Functionalization, the process by which the current carrying, and electron emissive properties are provided to the substrate, is open to many deposition and bulk techniques: ALD, CVD, PVD, Lithography, SOG, Spray, ... The basic requirements are that the layers can be targeted for resistance and electron yield, are conformal and uniform, do not inhibit device assembly, and inexpensive in volume.

Barrier Film	Example ALD film	Generic
· Composition	Al_2O_3	
· Thickness	>50nm	>50nm
· Uniformity	<2%	<10%
Resistive film	Example ALD film	Generic
· Composition	Pt nanoparticles in an Al_2O_3 matrix	
· Thickness	30-60nm (40nm Target)	<1um
· Thickness uniformity	<5%	<10%
· Extinction Coefficient	~0.15 – 0.40	
· Extinction coefficient uniformity	<5%	
· Resistivity (100M Ω Device Target)	10^6 - $10^7 \Omega\text{-cm}$	10^6 - $10^7 \Omega\text{-cm}$ (10^{12} - $10^{14} \Omega/\text{Sq}$)
Device Resistance (in Vacuum)	50-500 M Ω (100M Ω Target)	50-500 MO Ω (100M Ω Target)
Emissive film	Example ALD film	Generic
· Thickness	4-8nm (6nm target)	4-8nm (6nm target)
· Thickness uniformity	<5%	<5%
· Index of refraction	>1.6	
· Index of refraction uniformity	<5%	<5%
Electrode Film	Example NiCr (80/20) Film	Generic
· Thickness	100nm	100-200nm
· Thickness uniformity	<20%	<20%
· Resitivity	$10^{-4} \Omega\text{-cm}$	$10^{-3} - 10^{-5} \Omega\text{-cm}$
· Endspoiling Depth	20-80 um	20-80 um
Device Gain in vacuum	>10,000 at 1200 Volts	>10,000 at 1200 Volts