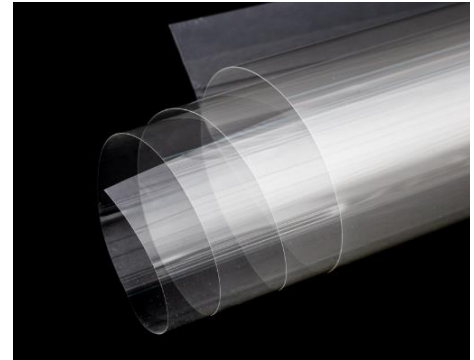


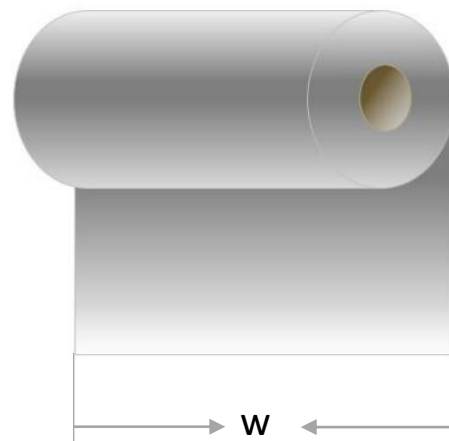
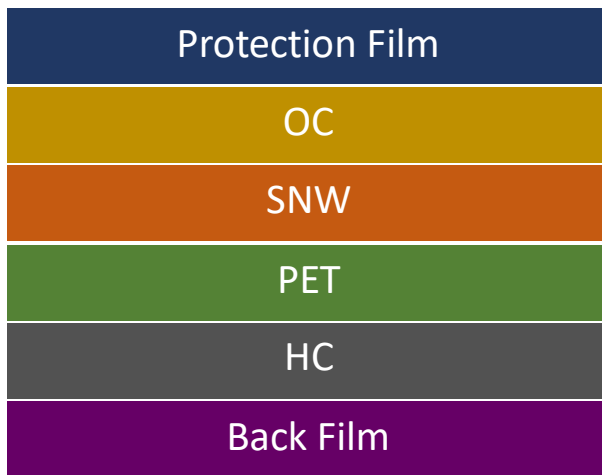
CPS-5030A1

General Description

Cambrios Film Solutions is the leader in silver nanowire solutions to enable the development of electronic devices with transparent conductors. Our proprietary nanostructured materials can be deposited using existing production equipment to achieve the enhanced performance of display and components at lower manufacturing costs.



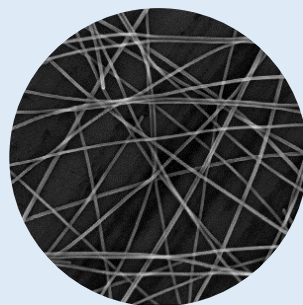
Stack Structure



Eff. Width = 1250mm

Features

- ✓ Superior Conductivity
- ✓ Excellent Stretchability
- ✓ High Transparency
- ✓ Without Line Visibility
- ✓ Remarkable Bendability



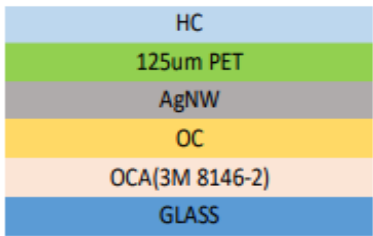
Application

- ✓ Touch sensor
- ✓ OLED lighting
- ✓ OPV devices
- ✓ Shielding film
- ✓ Healthcare

General Properties

Item	unit	Specification	Typical Value	Test Method
Thickness of TCF	μm	127±7	127	Thickness Gauge
Transmittance	%	> 90.0	92.0	Haze meter — ASTM D1003
Haze	%	< 2.0	1.70	Haze meter — ASTM D1003
b*(Trans.)	--	< 2.5	1.95	Spectrometer
Sheet Resistance	Ω/□	30±6	30.0	non-contact resistance meter
Rs Uniformity	%	≤ 10	≤ 10	-----
HC Hardness	H	≥ 1	1	ASTM D3363
HC Surface energy	Dyne	≥ 32	≥ 36	ASTM D2578
OC Surface energy	Dyne	≥ 34	≥ 36	ASTM D2578
HC Adhesion	B	≥ 4	5	ASTM D3359
OC Adhesion	B	≥ 4	5	ASTM D3359
Thermal Shrinkage	TD	%	< 0.8	CAM method, MD 145°C, 1HR
	MD	%	< 1.2	

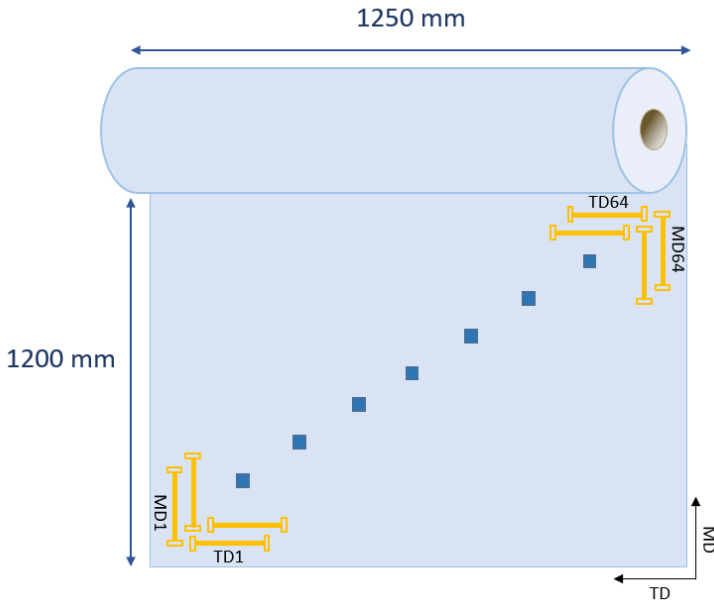
Note: All data are averaged results from production batches. Reasonable variations in data is expected.

Item	Unit	Rs change (ΔRs/R0)	Result	Test structure
High Temperature/Humidity	hrs	< 10%	>2,000	
High Temperature 85°C	hrs	< 10%	>2,000	
Thermal Shock 85°C → -40°C cycling	cycle	< 10%	>700 (~1,500hrs)	
UV stability Xe light 0.8W/m2 @ 420nm	hrs	< 10%	>3,000	

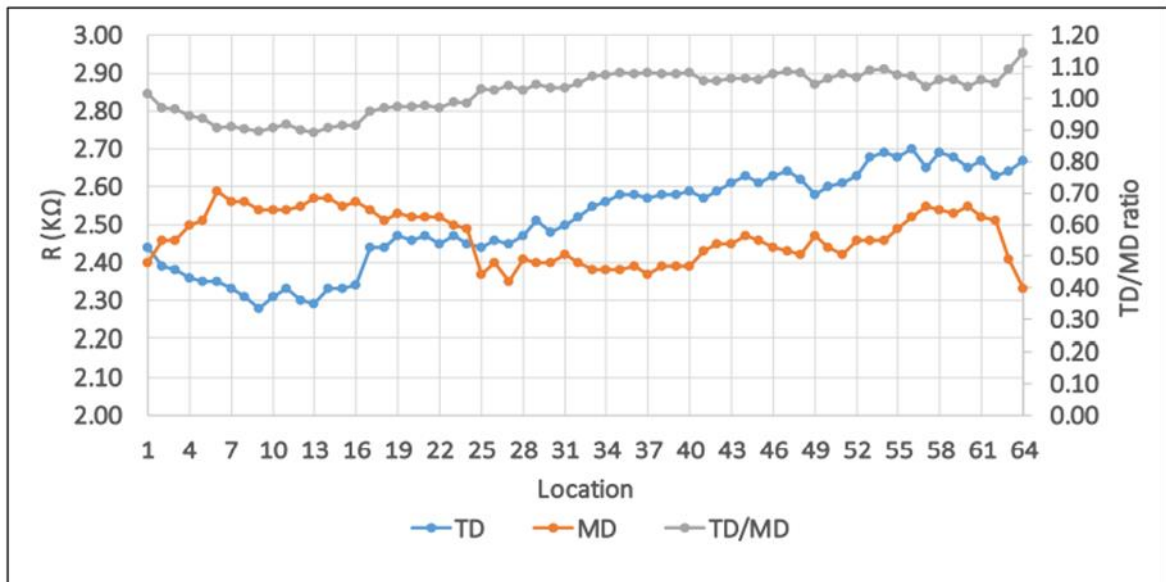
TD/MD Anisotropy

Test parameters

- Test key was fabricated by laser with a Length/Width of 100mm/1.25mm
- Measuring line resistance of TD and MD by a multi-meter
- Over 1200*1250 mm² area was measured

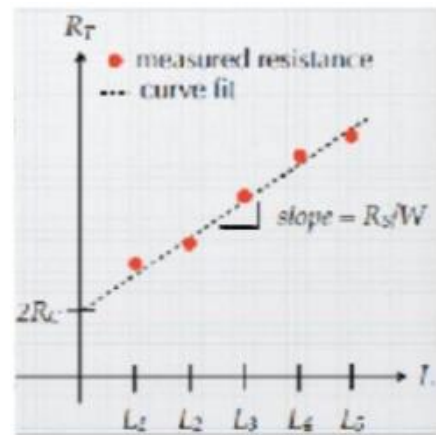
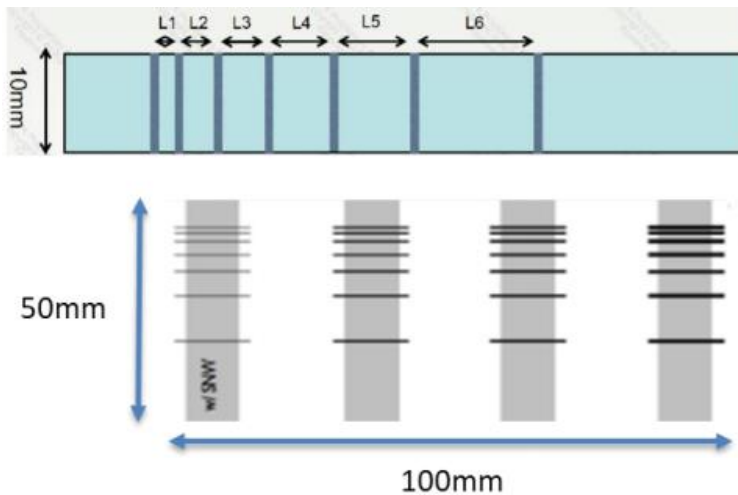


Item	Result
TD/MD	1.02
TD U%	8.43
MD U%	5.28



Contact Resistance (Rc) by TLM

- Ag Trace Dimension: 10mm X 100/200/400/800um (length x width)
- Ag Trace Space: L1~L6= 1, 2, 3, 4, 5, 8mm
- Ag Trace Material: Phoenix AW02 is recommended



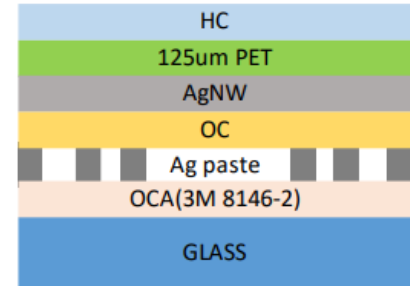
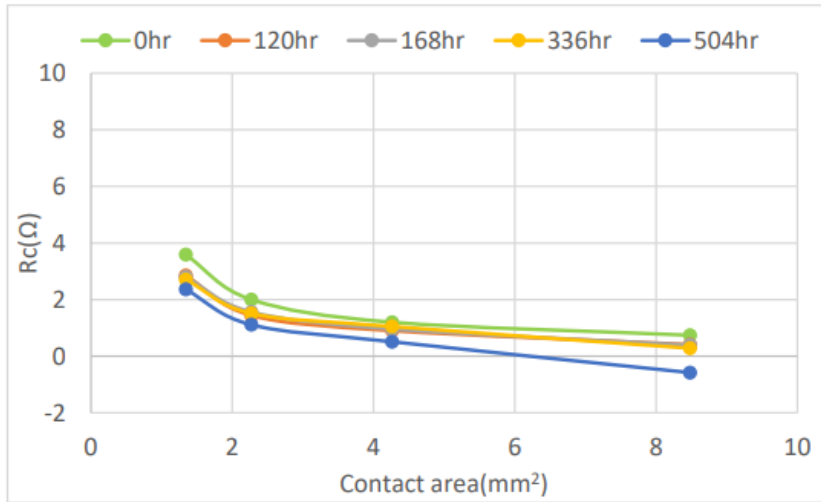
TLM calculation from R_{total} vs. Ag space fitting plot :

- (1) Measured $R_{total} = 2R_{Ag\ paste} + 2R_c + R_{SNW} = 2R''_c + R_{SNW}$
- (2) $R_{sheet} = \text{Slope} * \text{Ag line length}$
- (3) $2R_c = Y \text{ intercept}$, $2Ll = | X\text{-intercept} |$, $\rho = R_c/Lt * \text{Ag line length}$

Test Result of Contact Resistance

Line Width(um)	Contact Area(mm ²)	Rc(Ω) @ T=0hr	Rc(Ω) @ T=504hrs
100	1.0	4.27	2.36
200	2.0	2.06	2.27
400	4.0	1.12	0.51
800	8.0	0.61	0.58

85°C / 85 RH storage test



Shelf Life Test

Storage conditions

Shelf life	Condition	ΔR_s (%)	T%	Haze %	b*	Rc (Ω)
0 th week	40°C /90%R.H.	0.00	92.55	1.59	1.47	-
1 st week		-1.00	92.57	1.60	1.37	-
2 nd week		-0.03	92.50	1.61	1.34	-
3 rd week		2.44	92.50	1.60	1.29	-
0 th week	25°C /50%R.H.	0.00	92.58	1.60	1.46	1.75
1 st week		1.54	92.50	1.59	1.44	1.20
2 nd week		3.30	92.47	1.60	1.44	2.40
3 rd week		5.52	92.39	1.61	1.43	3.75
6 rd week		5.79	92.06	1.66	1.43	4.02

*Rc was recorded based on 1mm2 contact area

Reliability test

Shelf life	Condition	85°C/85R.H. test ($\Delta R_s < 10\%$)	Xe light test ($\Delta R_s < 10\%$)
0 th week	25°C/50%R.H.	> 2,000 hrs	> 3,000 hrs
6 th week		> 1,000 hrs	> 1,000 hrs
9 th week		> 1,000 hrs	> 1,000 hrs
12 th week		> 1,000 hrs	> 1,000 hrs