

表 3.1 異向性導電膠膜與異向性導電膏各種材料性質之比較[5]

Item		ACF	ACP
Advantages for use		Easy to handle at assemble company	No pre-heating
			High cost performance
Characteristic		Used for connecting with a fine circuit (min: 0.05mm pitch)	High shock-resistance because of softness
		Small sized conductive particles	Strong adhesion onto the surface of PET substrate
		Heat-resistance property (high T _g)	No change the concentration of conductive particles during heat-sealing process
		Acceptable for using constant-heating process	
Life for use		About 3 days	About 6 to 12 months
Connection resistance		Less than 0.5	
Peeling strength		More than 250N/m width	More than 500N/m width
Components of material	Conductive particle	Gold plated metal nucleus	Gold plated plastic nucleus
	Binder	Special epoxy resin	Special synthetic rubber plastic
Type of the binder material		thermosetting	Mixed with thermosetting and thermoplastic
Heat-sealing condition	Pre-heating	P 0.2Mpa, T 65oC, t=3s	None
	Final heating	P 3.5Mpa, T 160oC, t=20s	P 4Mpa, T 150oC, t=10s
About cost performance		The cost of ACP is quite cheaper than ACF. The material pree is about 1/11 of ACF	
Problem		Short life for use	Cannot used for connection with a fine circuit (less than 0.2mm pitch)
		Easy to broken	
		Weak adhesion onto the surface of PET substrate	
		Change the concentration of conductive particles around a heater chip during heat-sealing process	Need printing and curing equipments
		Expensive	Low heat-resistance

表 4.1 異向性導電膠膜靜態測試規格與方法[5]

Evaluation tests	Specification	Remarks
Peeling strength	More than 250N/m width	Using special tool (based on JIS C 6471), (testing speed: 50mm/min)
Shearing strength	More than $1.8 \times 10^6 \text{N/m}^2$	Using special tool (based on JIS C 7127)
R bending test (R: radius of curvature for bending tool)	More than R20	R value at the broken point of circuit connection for this R bending test
Connecting resistance	Less than 0.5	4 wired method
Insulation resistance	More than 10^8	Applied voltage: DC 250V. Time of applied voltage: 1 min
Withstanding test applied alternating voltage	Max AC 250V for Min spacing 0.15 mm	Without omission current of 0.5mA and more during the evaluation
Allowable current value	Less than 15mA	Applied voltage: DC 5.0V

表 4.2 異向性導電膠可靠度測試規格與方法[5]

Environmental test	Environmental condition	Specification for evaluation
High temperature storage	100°C x 250hr	Electrical specification: 1. connection resistance: less than 1 2. insulation resistance: more than 10^8 3. withstanding applied alternating voltage: Mix: AC 250V for min spacing 0.15mm
	80°C x 250hr	
	150°C x 3hr	
	120°C x 6hr	
R bent and high temperature storage	80°C. R10 bent x 250hr	Mechanical specification: 1. peeling strength: more than 250 N/m width 2. shearing strength: more than 1.8×10^6 N/m ²
High humidity and temperature storage	85°C. 85%RH x 250hr	
	60°C. 95%RH x 250hr	
Applied voltage and high humidity and temperature storage	85°C. 85%RH. DC 5V x 250hr	
	60°C. 95%RH. DC 5V x 250hr	Appearance specification: No deformation and discoloration as compared with initial appearance
Low temperature storage	-40°C x 250hr	
Thermal shock	Continuous 100 cycles (-30°C x 30min 80°C x 30min)	
Thermal cycle	Continuous 30 cycles (-30°C x 2hr (temperature changing: 2hr) 80°C x 2hr)	
Life cycle test	continuous 1,000,000 times by robber tool shaped R7 globular. (cycle time: 3 times/sec, impact load: 4.9N. robber hardness: 70 degrees)	

表 4.3 現行液晶面板廠對異向性導電膠膜之可靠度測試規格

COF 基板材料、COF 基板、COF 構裝及 LCD 組裝評估與驗證方法

項目	評估與驗證方法
無膠可壓合 PI 材料	<ul style="list-style-type: none"> ● 熱裂解溫度 $\geq 450^{\circ}\text{C}$ (TGA, $10^{\circ}\text{C}/\text{min}$, N_2, (5% Weight loss)) ● $T_g \geq 120^{\circ}\text{C}$ (TMA, $10^{\circ}\text{C}/\text{min}$, N) ● Volume Resistance $\geq 10^{15} \Omega\text{-cm}$ (ASTM-D257, 500V, 60sec) ● 介電常數 (Dielectric constant) ≤ 3.8 (ASTM-D150) ● 崩潰電壓 $\geq 5\text{KV}$ (ASTM-D149, 0.5 KV/sec) ● Water Absorption $\leq 2\%$ (ASTM-D570, 24hrs immersion) ● 剝離強度 $\geq 5\text{lb/in}$ (IPC TM650-2.4.9, receive, MEK $\square 10\text{mins}$, $200^{\circ}\text{C} \square 1\text{hr}$, Soldering ($288^{\circ}\text{C} \square 30\text{sec}$)) ● Flatness (波浪間距 1mm 以下) ● 溢膠性 (光學顯微鏡)
雙面接通軟性基板技術	<ul style="list-style-type: none"> ● 鉅錫性 (IPC TM650-2.4.12, IPC-FC-250, $245 \pm 5^{\circ}\text{C}$, $1 \pm 0.025\text{in}$, dipped $4 \pm 0.5\text{sec}$) ● Insurance Resistance (85°C, 85%R.H. 96Hr., Bias Voltage $100\text{V} \pm 10\%$) ● Peeling Strength (IPC TM650-2.4.8, Peeling Strength $> 5\text{lb/in}$) ● Hot-oil Test (IPC TM650-2.4.6, Room Temp. $\sim 260^{\circ}\text{C}$, 10/20/30/40/50 Cycles) ● Thermal Stress (IPC TM650-2.6.8, $288 \pm 5^{\circ}\text{C}$, $10 \pm 1-0\text{ sec.}$)
COF 構裝技術	<ul style="list-style-type: none"> ● Process Assessment (Bonding Strength $> 0.5\text{ Kgf}$, Curing Degree, Warpage) ● Short Term Reliability Test (Die-crack, Delamination) (JESD22-A112-A, 30°C, 60%R.H. 168Hr. + 3 IR-reflow) ● Long Term Reliability Test (PCI (121°C, 100%RH, 2Atm., 500Hr.), TCT ($-65^{\circ}\text{C} \sim 150^{\circ}\text{C}$, 1000Cycles), Migration Study) (JESD22-A102-A, JESD22-A104-A)
LCD 組裝技術	<ul style="list-style-type: none"> ● 高溫高濕 (60°C, 90% RH, 1000Hr.) ● 熱衝擊 ($-20^{\circ}\text{C} \sim 70^{\circ}\text{C}$, 10Cycles) ● 高溫 (70°C, 1000Hr.) ● 低溫 (-20°C, 1000Hr.) ● ESD (4KV Contact Discharge 8KV Air-discharge)

表 5.1 黏晶膠楊氏係數在各種溫度與應變率下有效試片數據表

溫度	應變率	有效試片數據(MPa)						平均
25°C	10 ⁻²	1534.9	1367.9	1156.5	1189.2			1237.8
	10 ⁻³	1143.2	986.37	1099.3	1006.9	1301.8		1107.5
	10 ⁻⁴	1032.7	1013.9	1056.2	968.58	1192.2		1073.8
	10 ⁻⁵	923.43	1002.9					963.17
75°C	10 ⁻²	218.48	467.90	290.41	228.76	277.30	178.80	226.95
	10 ⁻³	172.63	150.89	165.06	189.14	179.02	123.68	163.4
	10 ⁻⁴	171.22	121.18	112.41	133.71	153.10	125.68	129.22
	10 ⁻⁵	98.144	117.93	97.664	128.27	141.25		110.5
100°C	10 ⁻²	137.01	156.68	137.12	143.46	127.69	126.96	168.54
	10 ⁻³	147.15	162.3	169.19	127.69	136.87	121.22	149.15
	10 ⁻⁴	111.8	112.06	114.42	104.42	120.37	113.05	112.89
	10 ⁻⁵	94.696	105.39	89.908	103.98	105.38		104.92
125°C	10 ⁻²	91.138	128.51	97.078	141.76	146.11		138.79
	10 ⁻³	145.74	147.76	117.42	122.93	107.43		123.38
	10 ⁻⁴	111.9	125.05	104.94	107.43	104.38		110.74
	10 ⁻⁵	109.2	101.47	99.7	102.77	109.55		101.31

表 5.2 黏晶膠破壞強度在各種溫度與應變率下有效試片數據表

溫度	應變率	有效試片數據(MPa)						平均
25°C	10 ⁻²	13.689	14.184	16.451	16.282			15.152
	10 ⁻³	11.913	12.141	10.99	13.524	11.544		12.022
	10 ⁻⁴	9.6039	9.0524	9.7864	9.3825	10.524		9.6699
	10 ⁻⁵	10.303	8.9786	6.4738				8.5851
75°C	10 ⁻²	5.5534	6.8427	7.1728	6.3262	5.9572	6.5825	6.4058
	10 ⁻³	5.2184	5.0364	5.469	4.7816	6.6456	6.0704	5.5369
	10 ⁻⁴	3.7477	3.7476	3.3083	4.0218	5.1505	5.818	3.9952
	10 ⁻⁵	1.9142	2.7427	3.0955	3.8479	4.2314		3.7249
100°C	10 ⁻²	3.9881	5.2379	4.6469	4.9335	4.8997	4.7056	4.4983
	10 ⁻³	2.8914	2.8059	3.178	3.65	4.293	4.326	3.9782
	10 ⁻⁴	3.0979	3.4125	2.9852	3.1537	3.5703	3.4801	3.4042
	10 ⁻⁵	3.2375	3.1521	3.5935	3.3735			3.3392
125°C	10 ⁻²	3.1374	3.7719	5.095	3.7198	4.3897		4.0228
	10 ⁻³	2.7642	3.1024	2.9333	3.5065	4.6723		3.7604
	10 ⁻⁴	2.4027	2.8977	3.3496	4.2827	3.3922		3.3932
	10 ⁻⁵	2.6628	3.4228	3.389	3.8269	4.8236		3.1582

表 5.3 四種異向性導電膠膜的破壞強度在各種溫度下有效試片數據表

材料	溫度	有效試片數據 (MPa)						平均
ACF	25°C	63.169	63.383	68.131	65.852	68.344		65.7758
	75°C	38.694	43.234	41.424	43.368	38.442		41.0324
	100°C	26.338	28.353	28.440	25.489	25.576	25.151	26.5578
	125°C	15.2	20.905	17.144	19.028	17.344		17.9242
NCF	25°C	79.932	77.128	73.869	74.564	75.953		76.2892
	75°C	50.978	54.528	55.202	53.504	54.180		53.6784
	100°C	33.97	32.926	34.279	32.926	32.831		33.3864
	125°C	18.702	22.263	19.866	17.344	16.172		18.8694
ACF -10%	25°C	57.080	50.911	55.086	49.831	60.902	58.181	55.3318
	75°C	44.545	36.884	41.291	41.157	41.291	41.157	41.0542
	100°C	25.238	25.749	25.325	21.950	24.9	21.111	24.0455
	125°C	14.970	15.091	17.142	20.688	20.688	19.820	18.0665
ACF -20%	25°C	64.852	67.188	63.694	56.306			63.01
	75°C	47.411	46.840	47.982	48.7	48.129	45.844	47.4843
	100°C	33.246	31.169	32.095	34.386	32.724	30.861	32.4135
	125°C	18.858	20.499	23.420	20.360	18.507	20.074	20.2863

表 5.4 四種異向性導電膠膜的撥離強度在各種接合條件下有效數據表

材料	接合條件		有效試片數據(kgf/cm)						平均
	溫度	時間							
ACF	240°C	60sec	0.75	0.7807	0.8283	0.788	0.7857	0.7903	0.7872
		100sec	1.0573	0.9937	1.0267	1.0573	1.045		1.036
	260°C	30sec	0.5403	0.5817	0.592	0.585	0.5783	0.5663	0.5739
		60sec	0.9647	0.8833	0.945	0.8917	0.872	0.9563	0.9188
		90sec	1.055	0.9803	1.0097	1.094	1.0973	1.0583	1.049
NCF	240°C	60sec	0.7767	0.945	0.872	0.861	0.934	0.785	0.8623
		100sec	1.094	1.1327	0.9707	1.042	1.126		1.073
	260°C	30sec	0.5283	0.5643	0.5127	0.5903	0.4987	0.585	0.5466
		60sec	0.976	0.872	0.8103	0.9143	0.934	0.948	0.9091
		90sec	1.1667	1.198	1.1183	1.1287	1.1873	1.1633	1.1603
ACF -10%	240°C	60sec	0.4347	0.488	0.6397	0.4367	0.659	0.427	0.5142
		100sec	0.9847	0.9817	0.99	0.9563	0.9533	0.9367	0.9707
	260°C	30sec	0.2847	0.2713	0.4323	0.2757	0.4323	0.2663	0.3271
		60sec	0.7467	0.5847	0.768	0.5263	0.5823	0.5477	0.6259
		90sec	0.9283	0.9677	0.9817	0.9703	0.9733	0.9817	0.9567
ACF -20%	240°C	60sec	0.8163	0.6477	0.6217	0.6527	0.7997	0.6547	0.6988
		100sec	0.9633	0.936	0.9633	1.021	0.9513	1.012	0.9767
	260°C	30sec	0.433	0.433	0.6253	0.5763	0.433	0.598	0.5164
		60sec	0.8103	0.6588	0.8893	0.7207	0.8247	0.833	0.7894
		90sec	0.9873	0.9563	0.979	0.9677	0.9427	0.993	0.9637

表 5.5 四種異向性導電膠膜的撥離強度在各種溫度下有效試片數據表

材料	應變率	有效試片數據 (kgf/cm)						平均
ACF	25°C	1.0573	0.9937	1.0267	1.0573	1.045		1.036
	75°C	0.885	0.9757	0.9	1.0057	0.9757		0.9484
	100°C	0.9967	0.9667	0.9513	0.9483	0.888		0.9502
	125°C	0.861	0.8133	0.805	0.8133	0.7937	0.827	0.8189
NCF	25°C	1.094	1.1327	0.9707	1.042	1.126		1.073
	75°C	0.9847	0.9733	0.8693	0.962	0.9253		0.9429
	100°C	0.883	0.9513	0.9513	0.9057	0.9773		0.9337
	125°C	0.7373	0.6617	0.8103	0.8103	0.8803	0.9003	0.8
ACF -10%	25°C	0.9847	0.9817	0.99	0.9563	0.9533	0.9367	0.9707
	75°C	0.8893	0.805	0.8833	0.8247	0.8947	0.875	0.876
	100°C	0.8183	0.8487	0.8787	0.897	0.8063	0.8697	0.853
	125°C	0.7717	0.712	0.7967	0.7637	0.6653		0.7415
ACF -20%	25°C	0.9633	0.936	0.9633	1.021	0.9513	1.012	0.9767
	75°C	0.869	0.814	0.8947	0.9163	0.821	0.8837	0.8663
	100°C	0.7143	0.8023	0.7973	0.8077	0.8077		0.786
	125°C	0.6953	0.757	0.6027	0.7517	0.8637	0.9113	0.7636

表 5.6 四種異向性導電膠膜的撥離強度在高溫老化下有效試片數據表

材料	時間 (小時)	有效試片數據(kgf/cm)						平均
ACF	24	1.1553	1.1917	1.1333	1.1297	1.2177	1.1627	1.165
	48	1.1047	1.1463	1.214	1.181	1.2397		1.177
	72	1.1533	1.1607	1.118	1.1803			1.153
	120	1.28	1.2103	1.2653	1.2213	1.2583	1.2433	1.2463
	250	1.3127	1.287	1.287	1.1393	1.2613	1.1703	1.243
	500	1.2817	1.3257	1.3163	1.2783	1.2943	1.3353	1.3053
	1000	1.368	1.234	1.307	1.3203	1.368	1.234	1.2948
NCF	24	1.2213	1.291	1.166	1.28	1.2837		1.2483
	48	1.269	1.240	1.2327	1.28	1.2103	1.2177	1.2417
	72	1.297	1.2427	1.2427	1.219	1.305	1.1297	1.2497
	120	1.2773	1.2037	1.192	1.169	1.266	1.2583	1.2457
	250	1.272	1.288	1.313	1.3953	1.373	1.3417	1.3307
	500	1.3763	1.2343	1.3827	1.411	1.3763	1.329	1.3517
	1000	1.359	1.3207	1.316	1.359	1.3547	1.3203	1.3326
ACF -10%	24	1.0973	1.0193	1.0453	1.042	0.9903	0.9673	1.027
	48	0.9523	1.0457	1.0457	1.0563	1.0807	1.1213	1.0503
	72	1.1667	1.0977	1.1667	1.1217	1.0077	1.0597	1.1033
	120	1.159	1.148	1.111	1.1257	1.17	1.1917	1.132
	250	1.1517	1.0507	1.1463	1.106	1.0507	1.1263	1.1053
	500	1.2943	1.1363	1.127	1.1363	1.0607	1.152	1.151
	1000	1.0457	1.215	1.198	1.2103	1.16	1.148	1.1619

ACF -20%	24	0.971	1.0777	1.045	1.057	1.057		1.0417
	48	1.1163	1.1163	1.0907	1.0747	1.11	1.126	1.1057
	72	1.0803	1.077	1.0077	1.0217	1.0697	1.0427	1.05
	120	1.0963	1.0707	1.1993	1.0783	1.1627	1.093	1.104
	250	1.135	1.119	1.1457	1.1107	1.0973	1.1	1.118
	500	1.1807	1.1913	1.2363	1.2197	1.2593	1.243	1.2217
	1000	1.2507	1.1993	1.2543	1.2397	1.2063	1.2177	1.228



表 5.7 四種異向性導電膠膜的撥離強度在高溫高濕老化有效數據表

材料	時間 (小時)	有效試片數據(kgf/cm)						平均
ACF	24	1.24	1.121	1.245	1.25	1.245	1.245	1.2243
	48	1.212	1.198	1.198	1.2187			1.2067
	72	1.016	1.0517	1.1133	0.9837	1.1	0.9903	1.0537
	120	0.9803	1.0063	1.1327	0.9673	1.026	0.9903	1.0173
	250	0.9237	0.9237	0.9457	1.0273	0.937	0.9633	0.9517
	500	0.9523	0.9967	1.0053	0.959	0.906	1.003	0.9703
	1000	1.039	1.0453	1.0357	1.0323	1.039	1.0647	1.0643
NCF	24	1.402	1.3333	1.3853	1.316	1.2687		1.341
	48	1.212	1.0873	1.018	0.949	1.1633	1.0217	1.0753
	72	1.1133	1.1133	1.0617	0.963	1.1323	1.15	1.102
	120	0.9813	1.0057	0.9847	1.03			1.0003
	250	0.9213	0.9103	0.9853	0.97	0.8883	0.9347	0.935
	500	0.8183	0.896	0.8447	0.9167	0.86	0.822	0.8517
	1000	1.0177	0.9787	1.0087	1.003	0.9907		0.9997
ACF -10%	24	1.2047	1.1463	0.994	1.2083	1.1323	1.1807	1.1443
	48	1.0977	1.0733	1.198	1.1083	1.1047	1.1667	1.1247
	72	1.1873	1.018	1.1357	1.077	1.063	1.1287	1.1017
	120	1.054	1.0087	1.0603	1.042	0.9393		1.0207
	250	1.011	0.8737	0.9447	0.8737	1.037	0.9447	0.942
	500	1.127	1.0913	1.101	1.1363	1.149	1.006	1.0597
	1000	1.0267	1.024	1.033	1.0353	1.039	1.101	1.0572

ACF -20%	24	1.1807	1.1807	1.1943	1.198	1.16	1.1633	1.1797
	48	1.177	1.1427	1.2013	1.1807	1.2013	1.1807	1.1807
	72	1.0907	0.9673	1.042	1.0743	1	1.0293	1.034
	120	1.0647	1.094	0.9707	0.9967	0.987	1.013	1.021
	250	1.101	1.0417	0.9587	1.1173	0.9493	1.0037	1.0257
	500	1.192	1.096	1.1187	1.2047	1.114	1.23	1.1643
	1000	1.1923	1.2297	1.1473	1.201	1.205	1.1437	1.1962

