

Application Note

A Study of the Effect of Copper Surface Preparation on Adhesion to Fluoropolymer Films

Historically brown and black oxide treatments were not compatible with the use of fluoropolymer film adhesives due to the inability to withstand higher lamination temperatures required for processing. Additionally, the recommendation of a micro etched copper surface was not deemed reliable for use with fluoropolymer films. A study was put together to investigate the effect of varied copper surface preparation, including alternative oxide treatment, on adhesion to different fluoropolymer films.

The study was performed on XtremeSpeed™ RO1200™ laminates 0.005 inch (0.127 mm) thick clad with 0.5 oz ED copper bonded together using a variety of adhesives. The adhesives used include 0.0015 inch (0.0381 mm) thick CuClad® 6250 adhesive, 0.0015 inch (0.0381 mm) thick CuClad 6700 adhesive, 0.001 inch (0.0254 mm) thick FEP adhesive, and 0.003 inch (0.0762 mm) thick XtremeSpeed RO1200 Bondply.

Table 1. Bond temperature of adhesives used.

Adhesive	Temperature
CuClad 6250	275°F (135°C)
CuClad 6700	450°F (232°C)
FEP	550°F (287°C)
XtremeSpeed RO1200 Bondply	700°F (371°C)

XtremeSpeed RO1200 laminates were prepared as is, after micro etch only, after micro etch and a 1 hour bake at 150°C, and after micro etch and alternative oxide treatment. Samples were cut into 0.25 inch (6.35 mm) wide strips and measured for adhesion through T-peel tests consistent with ASTM D1876. Samples were placed into peel test grip fixtures such that the bonded area would stick out horizontally forming a “T” shape and measured as the force required to produce progressive separation. Image of test configuration is available in Appendix.

Two measurements were taken:

1. T peel strength was measured at ambient temperature of 21°C
2. T peel strength was measured at ambient temperature of 21°C after a 5 hour bake at 150°C
 - a. The 5 hour bake was added to simulate various process bakes

\\ \\ Table 2. Average T peel test results of fluoropolymer films as is.

Peel Strength (PLI)				
	CuClad 6250	CuClad 6700	FEP	XtremeSpeed RO1200
As is	4.78	0.25	1.08	4.18
Micro Etched	6.68	0.59	1.16	9.72
Micro Etched + Baked	2.37	0.85	1.04	6.64
Micro Etched + Oxide Treatment	7.74	3.95	8.50	9.88

\\ \\ Table 3. Average T peel test results of fluoropolymer films after 5 hour bake at 150°C.

Peel Strength (PLI)				
	CuClad 6250	CuClad 6700	FEP	XtremeSpeed RO1200
As is	10.01	0.35	1.22	4.47
Micro Etched	8.30	1.02	1.37	6.93
Micro Etched + Baked	1.83	1.02	1.20	6.43
Micro Etched + Oxide Treatment	8.71	3.74	8.49	10.24

Figure 1
Average T peel test results of fluoropolymer films as is.

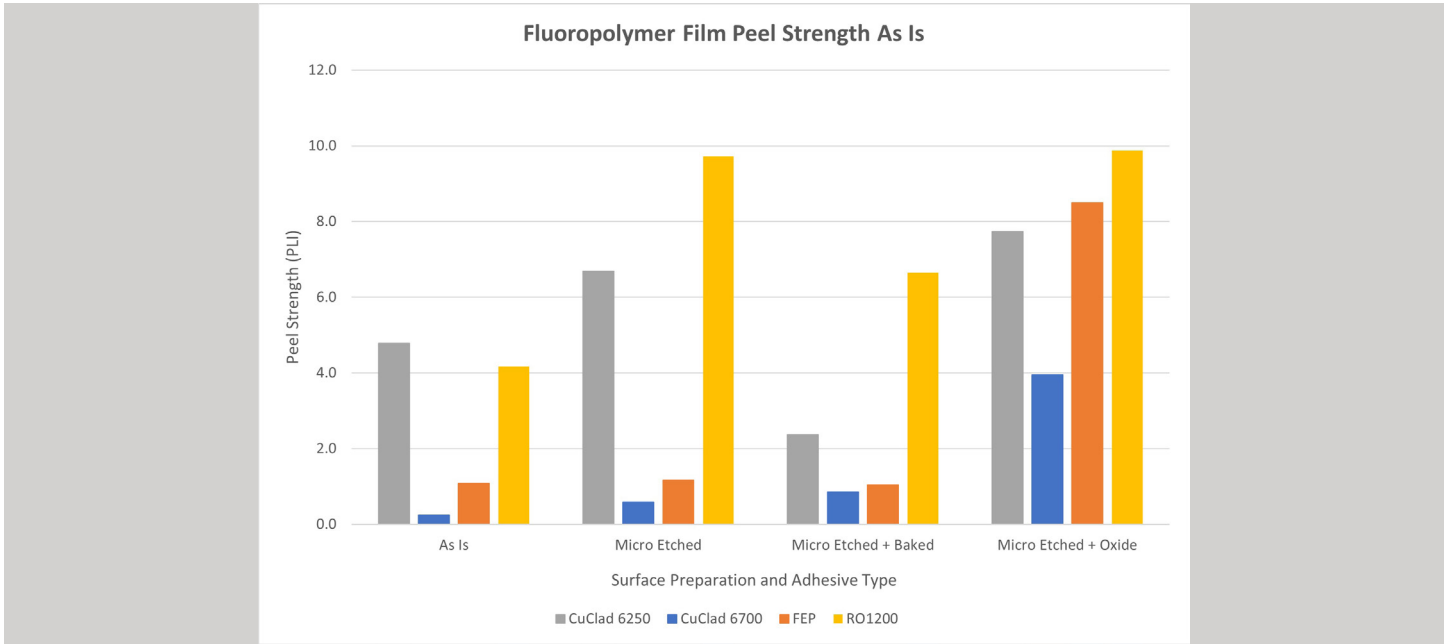
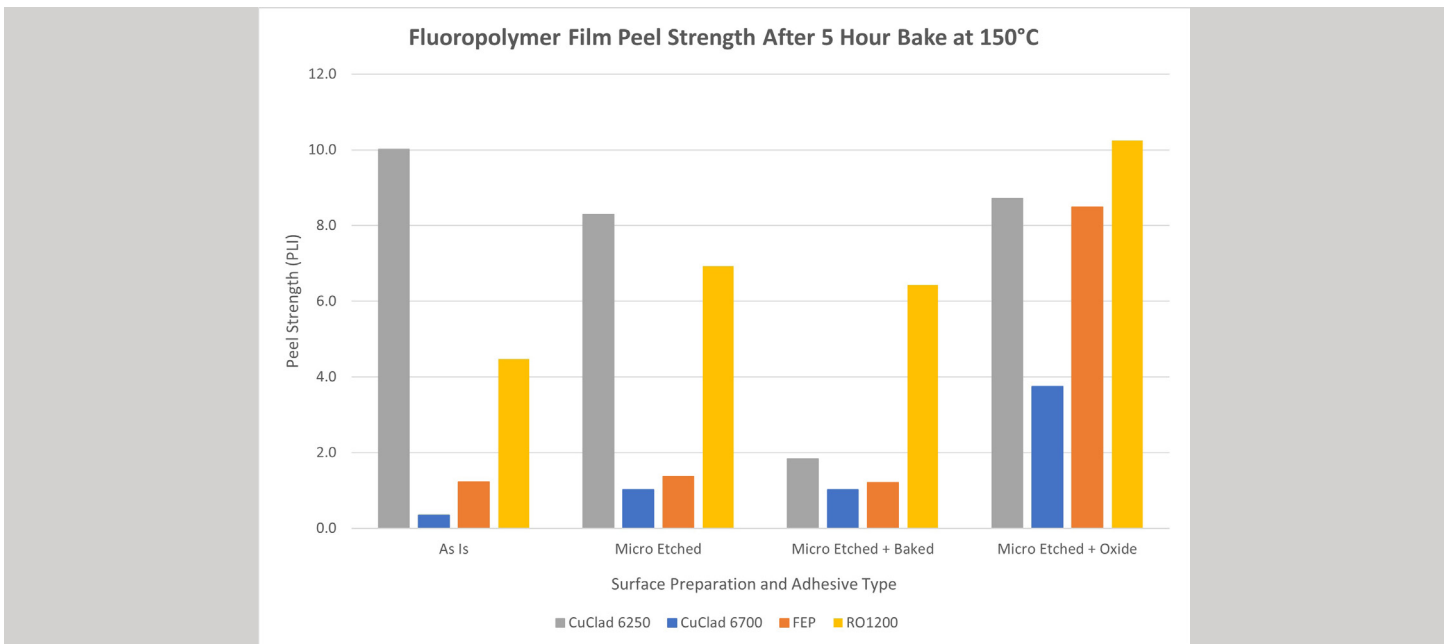
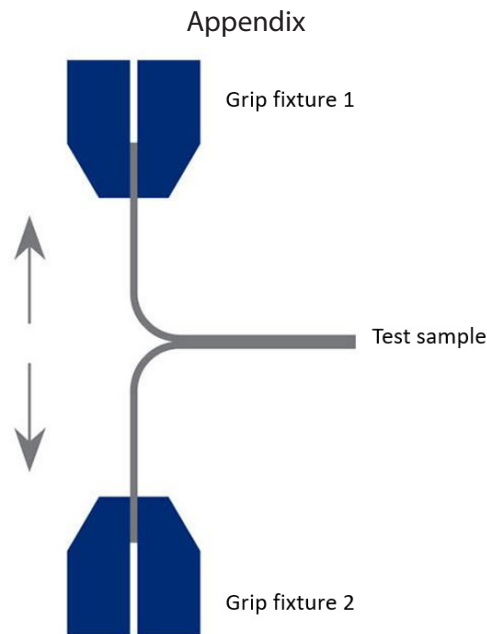


Figure 2
Average T peel test results of fluoropolymer films after 5 hour bake at 150° C.



The T peel tests show that alternative oxide treatment of copper surfaces can be used to increase the adhesion to fluoropolymer films. Both a micro etch and alternative oxide treatment have greater adhesion compared to copper surfaces left as is. Alternative oxide treatment achieved the highest adhesion to fluoropolymer films out of all the copper surface preparation methods. The 5 hour bake was to simulate exposures and bakes typical of PCB fabrication processes. No blisters or delamination was observed after the bake. There is also no significant change in peel strength after this bake, indicating that alternative oxide treatment can withstand similar exposures. The alternative oxide treatment continues to have the highest adhesion to fluoropolymer films out of the varied copper surfaces



This figure demonstrates the sample and fixture setup used to complete a T peel strength test.

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