Technical Information

Thin Material Transport Capability

Introduction

As substrate materials have become thinner and more flexible, transporting and etching these substrates in horizontal conveyorized etchers without damage and without resorting to leaders is a major problem. Increasing the density of the wheels solves the transport problem but causes major interference with etch speed and quality. Chemcut has developed a Thin Material Transport (TMT) conveyor that will transport the most flexible substrates without leaders with minimal loss of conveyor speed and excellent etch quality.

Description

Chemcut's conveyor rods are spaced 1 $^{5}/_{8}$ inches (42 mm) apart. By using 2 inch (50 mm) diameter conveyor wheels, slightly offset from rod to rod, the wheels overlap each other from rod to rod, making it impossible for the leading edge of a flexible panel to slide down between them to the bottom of the etcher. The problem has been to provide enough support between wheels on a rod without interfering with the etching. The heart of the TMT system is the 'S' wheel. The rim of the 'S' wheel snakes back and forth around the circumference of the wheel in an S pattern rather than a straight line. The width of the pattern is 1 inch (25.4 mm) so that the most support with the least masking of the lower spray is offered. However, it is difficult to get the 'S' wheels close enough together to provide reliable transport of very flexible materials without interfering with the wheels on the next rod. This problem is resolved by using the 'S' wheel on every other rod and putting two soft wheels with a straight, rather broad, rim on the adjacent rods so the rims fall between the 'S' wheels as in the photo below.

Chemcut Thin Material Transport Conveyor

Transport Capability

Transport testing has shown that the Thin Material Transport conveyor can convey flexible and thin materials down to 1-mil (25 µm) bare polyimide (no copper) without leaders, with no skewing or movement and without damage through etch, rinse and dry with bottom spray pressures up to 15 psi (1 bar) higher than the top spray pressure. It has also shown it can transport copper clad flex panels without leaving marks or impressions in the copper.

Etch Tests

Etch tests were done in a single chamber cupric chloride etcher using 18" x 12" (457 mm x 305 mm) panels with 3 mil (75 µm) line and space test patterns on 1 oz. (35 µm) foil. Conveyor speed for the Thin Material Transport conveyor was 22 ipm (0.56 m/min.) compared to 25 ipm (0.64 m/min.) for the same etched line width with the standard conveyor. The etch results for the bottom sides of the panels are shown in the etch maps on the next page. The first pair shown are etched line width maps obtained using an automatic optical scanner (AOI) on panels with a 5 mil (125 µm) Teflon core, one run with the standard conveyor system and the other with the Thin Material Transport conveyor replacing the standard conveyor in the same etcher. The second pair are 3-D surface charts of line width vs. panel location of the same panels obtained using resistance measurements to calculate the line widths.

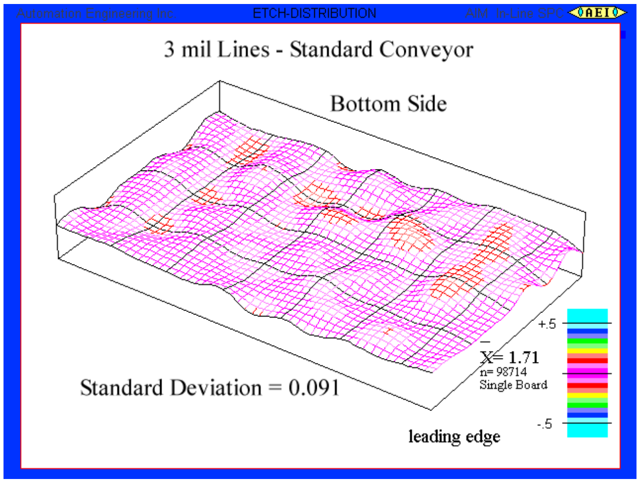
The optical scans show that, except for a slightly different pattern of high and low points, there is little difference in the etch uniformity for the Thin Material Transport conveyor when compared to the standard conveyor. Each different color represents a difference of 0.05 mils (1.27 µm) in line width. Both etch maps show only three colors, representing a range of ± 0.15 mils (3.81 µm) from the average line width.

Using resistance measurements to calculate etched line widths tends to be a little more sensitive than our optical scanner at 3 mil lines and spaces or less. As a result, the 3-D surface plots of the same panels as above generated by this data show a slight decrease in etch uniformity for the Thin Material Transport conveyor when compared to the standard conveyor. The standard deviation for the standard conveyor was 0.079 and the range was ±0.18 mils (4.57µm) from average while the Thin Material Transport conveyor had a standard deviation of 0.087 and a range of ±0.21 mils (5.33 µm). To put these numbers into perspective, Chemcut has found an etcher capable of doing ultra-fine line etching (3 mil lines and spaces in 1 oz. foil, 2 mil lines and spaces in ½ oz. foil and 1 mil lines and spaces in ¼ oz. foil) must have a standard deviation of less than 0.100 when using this method and test pattern. Even with the slight loss in etch uniformity found in these tests an etcher with the Thin Material Transport conveyor is still well within the uniformity range needed for ultra-fine line etching.

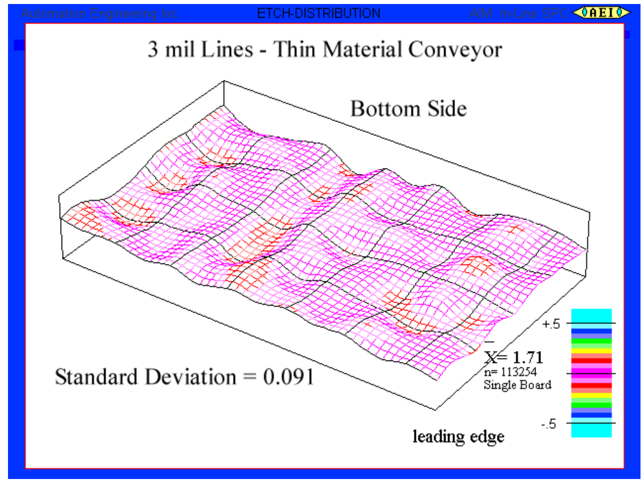
Conclusions:

The Thin Material Transport conveyor as described above is capable of transporting thin and flexible panels reliably without the use of leaders, with no damage or impressions in the copper foil. It is still capable of providing excellent etch uniformity with minimal loss of conveyor speed or productivity.

Optical Scan Results

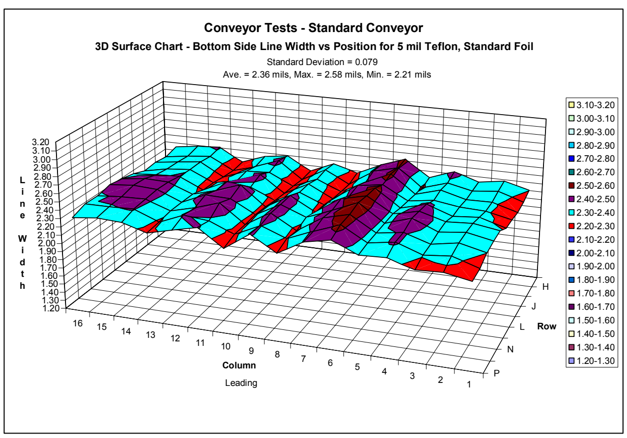


Standard Conveyor

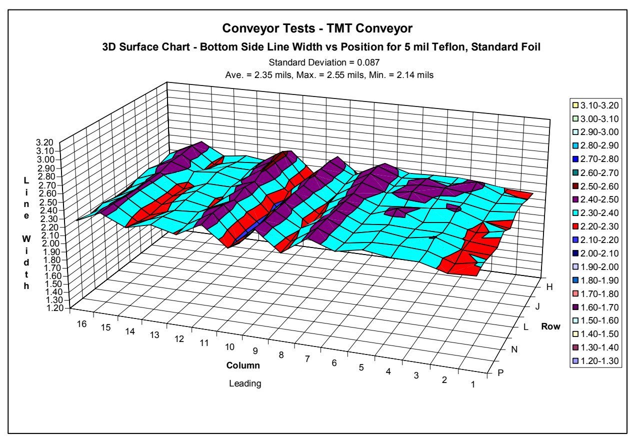


Thin Material Transport Conveyor

3-D Surface Plots of Line Widths Calculated from Resistance Measurements



Standard Conveyor
Std.dev. = 0.079
Ave.LW= 2.36 mils
Max.LW= 2.58 mils, Min.LW= 2.21 mils



Thin Material Transport Conveyor
Std.dev. = 0.087
Ave.LW= 2.35 mils
Max.LW= 2.55 mils, Min.LW= 2.14 mils