Programming Considerations in Complex Wave Form Pulse Reverse Plating: Part 1, Developing the Tool

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Abstract

With the advent of more flexible versions of pulse-reverse plating technologies, and with the ability to program more of the waveform parameters, comes an increased number of options facing the user. An impediment to the rapid determination of the optimum programming parameters in any via-plating system is the very large numbers of test runs this can generate, and the very time-consuming cross-section evaluations needed to assure that valid decisions are made. Similarly, this "cross-section proliferation" problem faces platers contemplating any other plating process options (eductor placement, vibration equipment, agitation changes, chemical changes, etc.)

Building on an idea put forward by Yair Assaf at AESF SurFin 2002, this paper reports on experimentation using a test unit to allow programs to be pre-screened without cross-section verification, in comparison with conventional cross-section evaluation. The test unit is designed to be used by itself, or to accompany parts through the plating cycle, and consists of a tapered-gap, with a removable copper tape as plating substrate. All this is to permit better/faster/less burdensome realization of the benefits of complex wave form pulse reverse systems in via formation.

It is our hope that others in the industry will expand on this idea to the point that it can be developed into a useful, reliable tool.

Background

Cross section analysis is far and away the most widely accepted method of assessing plating response in use today. As RBP (and other suppliers and users of advanced plating techniques) try to convert the potential of pulse plating, eductor placement, novel chemistries, etc. into commercially viable, easily-implemented means of production, the need to prepare and measure thousands of cross sections becomes a major delay. No altruism was involved, we were just awash in cross-sections.

Yair Assaf's earlier work used a fixed-gap set of parallel conductors and measured "throwing power" by the change in thickness of plating deposit the further in one measured from the edge. As employed, this still required cross-section mounting and microscopic measurement of the plated deposit thickness. We concluded that something was needed that could quickly screen large numbers of possible combinations of plating parameters, eliminating less-promising combinations, allowing one to more quickly focus on those that showed promise.

Apparatus

By punching samples of consistent size, any difference in weight between two specimens (discounting experimental error) could be attributed to differences in plating deposition thickness at the conditions prevalent in that location. By fixing the distances along the tapered gap for all samples (on the inside track at least) a measure approximating the effect of varying aspect ratio could be attained. See Figures 1 and 2.

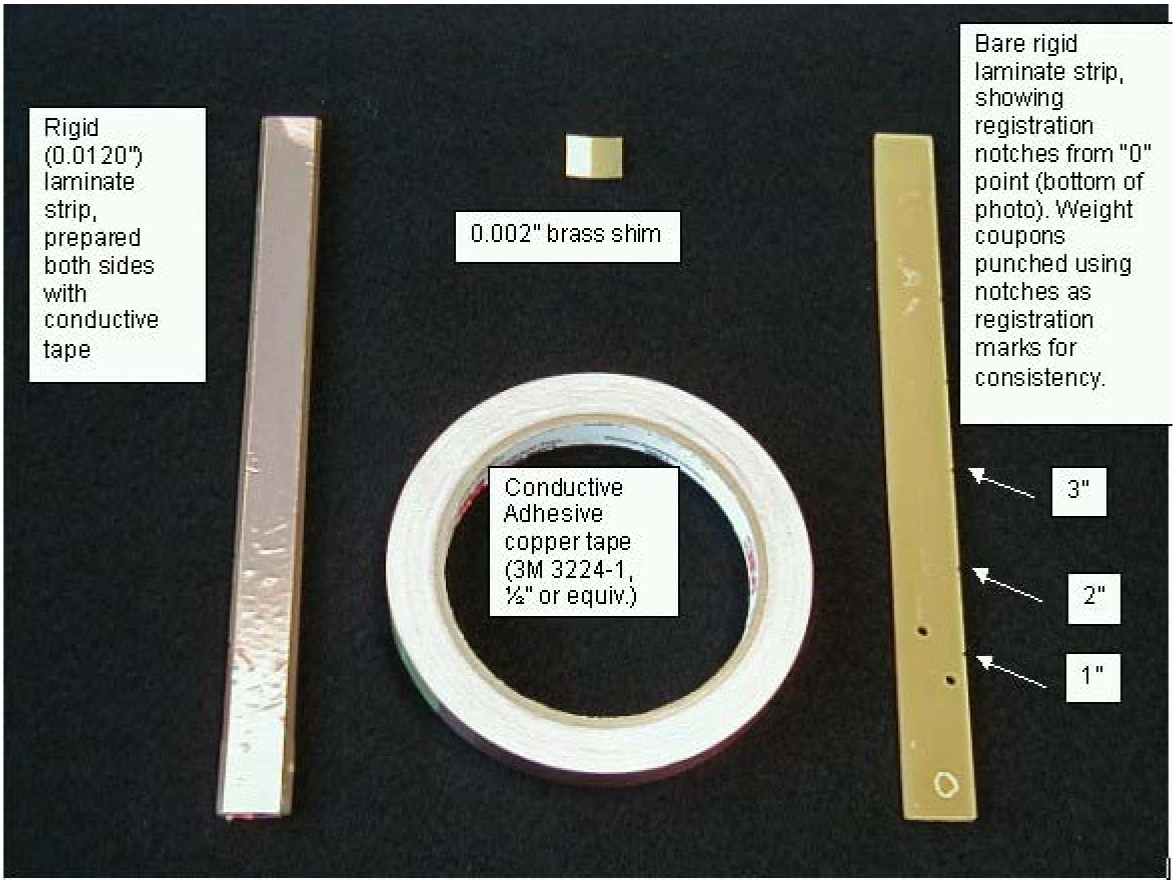

Figure 1 – Equipment for Fixing Distances

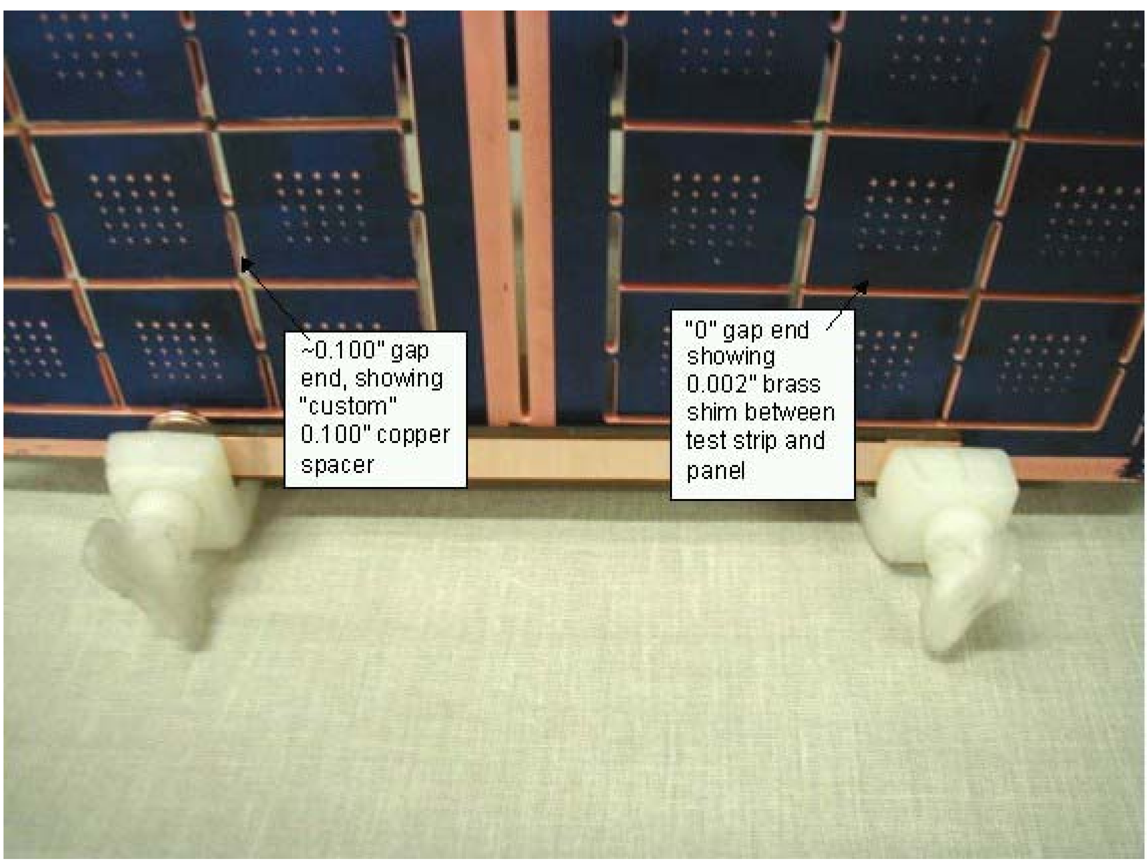

Figure 2 – Tapered Gaps

Results

Results are depicted in Table and 1 and Figures 3 and 4.

Table 1 – Data Example

Data Collection: Example

"Inside"	"Outside"	"Inside"	"Outside"	
CU001 Pattern (21 ASF)				
21 ASF, lo CU505A (0.05%)				
Gross Weights		Weight Gains		% "Throw"
0.0172	0.0256	0.0026	0.0110	25%
0.0187	0.0246	0.0041	0.0100	39%
0.0202	0.0251	0.0056	0.0105	53%
0.0208	0.0253	0.0062	0.0107	58%
0.0214	0.0258	0.0068	0.0112	64%
Avg	0.0252		0.0107	

Tare Wt,	BaseWt,gm.
Cu tape	0.0150
	0.0151
	0.0143
	0.0144
	0.0145
	0.0146
	0.0147
	0.0140
Average	**0.0146**
Std.Dev.	**0.0004**

Test Cell Geometry		
DeltaGap/Inch		0.01568
Position	Gap	Eff: A/R
1	0.018	36
2	0.033	17
3	0.049	12
4	0.065	8
5	0.080	7

Discussion

Clearly, these tests need to be replicated many times in order to develop confidence in the validity of this proposed screening method. The limited samples processed in parallel so far, and reducing the inherent variation in both optical cross-section measurements and in the preparation and weighing of the samples from the test cell are among the areas of continuing work.

We do see some encouraging signs in the test cell's prediction of the superiority of a program which has (in the field) consistently been a strong performer. There also appears to be general agreement in relative performance rankings between tests evaluating program variables, current density, and other parameters evaluated. (See Table 1 and Figure 3.)

The prospect of a more rapid method of pre-screening test to evaluate plating parameter changes prompts us to ask whether others might want to try to improve on this admittedly crude start and see if it could be developed into a us
eful industry tool.

Conclusion

Limited testing comparing conventional cross-section measurement with a test cell using weight gain in selected areas to determine the effectiveness of plating process changes has been performed. There is sufficient indication of correlation to warrant expanded evaluation.

Acknowledgements

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Bohak Plating Co. Ltd.
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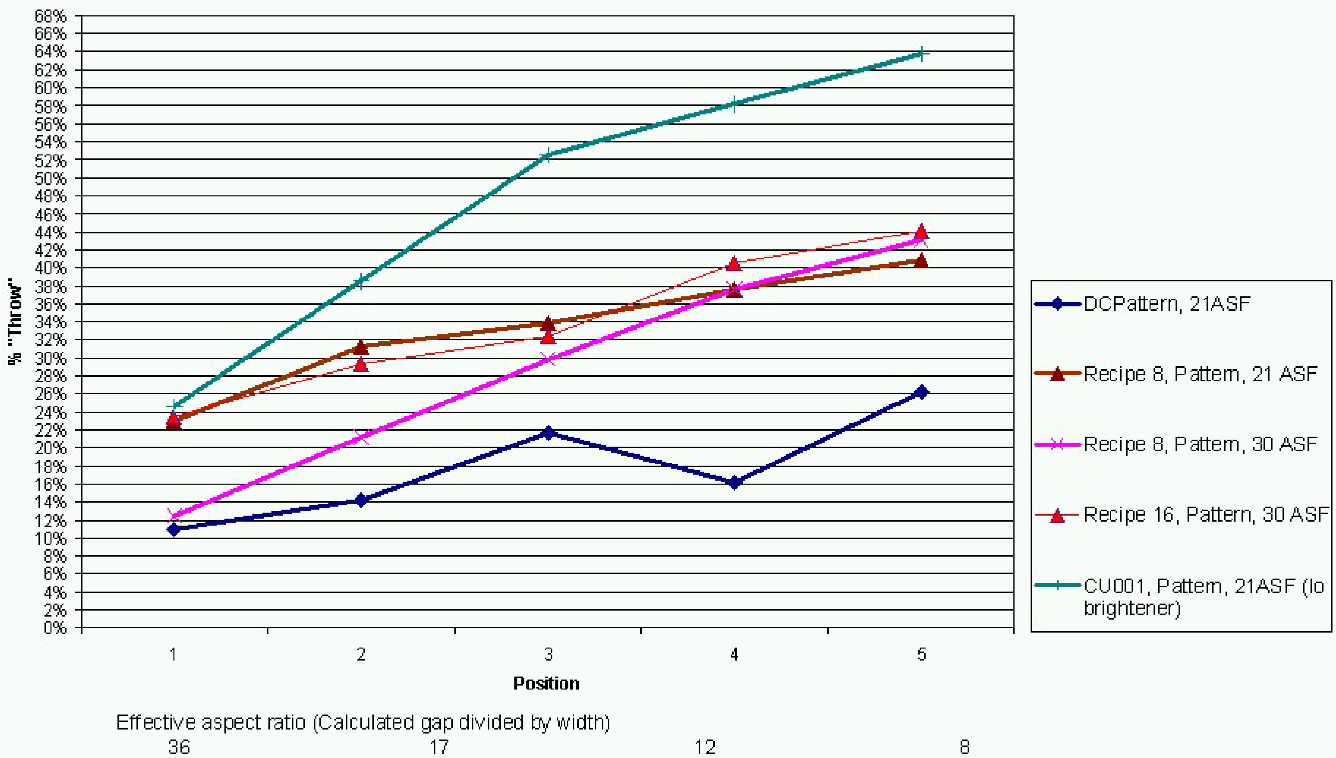

Figure 3 – Test Cell Results Percent "Throw" vs. Aspect Ratio

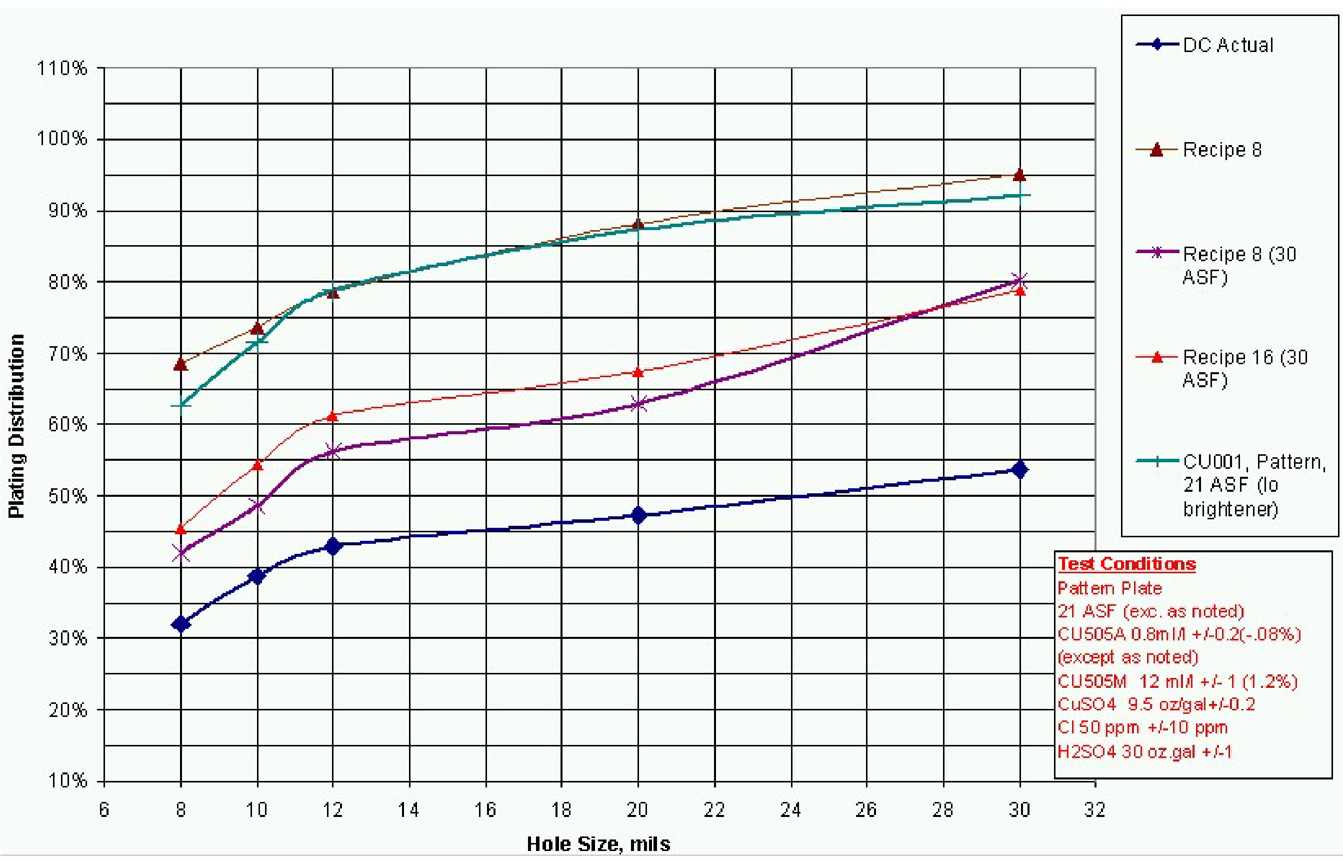

Figure 4 - Plating Distribution vs. Hole Size in ~0.125" Panel