PulsePlating

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PulseBarrelPlating

Well, it's the first of January 2000 A.D., and my computer still works. Woz wrote the ODB to incorporate date change completely eliminating any potential concern for Y2K problem way back in 1982. I had NO FEAR anyway, except that with AESF Week around the corner I was going to have a by-line for the March issue (that you're now reading) because no one else has stepped up to bat. Or, maybe no one else is reading it and knows about the offer.

A word of advice comes from the founding Apple programmer. If you plan ahead, you forewarn and are thus best forearmed. I have a recent Q/A dialog that I would like to give this month.

Hello Steve,
I have a question for you. I manage a plating shop and we are plating a part that requires 50-millionths of gold on a spot near the end of a 1.5-in.-long part that is about 0.070 in. in diameter. Is there a way to program my pulse plater to get even more plating on the ends of the part without increasing the thickness in the middle of the part? I realize that pulse plating is usually used to get the opposite result, but I would appreciate any ideas you may have or leads on anyone else who may be of help.

Dear Sir,
Thanks for the challenging question. My first thoughts were whether you make contact or barrel plate. Obviously, you don't contact the end(s) if that's where you want more thickness. However, that's where you want to make contact if you can, so that when higher current pulses appear for any significant amount of time, there would tend to be the dogbone buildup there. Not knowing how you rack or what's optional based on the function of the part, like barrel plating, tends to limit the imagination to plate as desired. Why do you need more at the ends? And does it need to be right next to the end or the entire end covered? Once you idealize the normal plating configuration to take advantage of end buildup, then consider electrolyte composition to enhance the setup and synergize the pulse efficacy. In other words, trying to take a schlock or out-of-balance solution and pulse with fancy waveforms won't get you too far. Pulse can only make better that which is already good. If the solution is designed for a type of duty and frequency, then getting fancy on the waveform ramping parameters can really help the surface design.

Next, the rectifier you use is what brand? Please go ahead and indicate how you do it now, what the part's function is, as well as what and why you need such build and the ideal functional shape of the epiphyses of the dogbones (sorry, epiphysis is the bone's end-something not normally used in plating circles—just a joke). Also, which type of gold bath are you using and what type gold is needed for the part?

Thanks, Steve

Steve,
Thanks for the prompt response. You raised several questions that I will attempt to answer here. I hope this info helps to clear up any questions.

1. The parts are plated in an 8-in. x 18-in. Sterling fine-mesh plating barrel.

2. The parts are part of an electrical connection circuit that has a sliding contact on one end, hence the need for the plating to be 50-millionths thick at that point. The measurement point is about 0.1 in. from the end of the part.

3. The bath we are using is a brand new makeup of a cobalt-hardened gold from Lucent that runs about 0.5 troy oz/gal of gold.

4. The rectifier we use is a Dynatronix.

Best Regards

Sir,
This is the best I can come up with. In barrel plating, there is a tendency for making and breaking current contact, but it isn't exactly pulsing. There should also be a tendency for dogboning if a sufficient number of danglers and current is used.

One effect pulsing can give is a distorted dogbone effect, much like direct-current plating, because the pulses are like little direct current ones. What can be done by pulsing is maximize the current density for a finite amount of time to enhance dogboning. The amount of current and length of time are related to the type of gold bath used and the concentration of gold in that bath. You need only 0.00007 in. hard gold plating 0.10000 in. from the end(s), making the go/no-go measurement of 0.07005 in. You also want pulse-enhanced dogboning with the sliding contact geometry. So, in essence, you need 50-millionths on a spot one-tenth of an inch from the end. Because we

don't know if there is a geometry associated for the "spot" region or the exact starting material and how it is fabricated, we will assume it is steel that is saw-cut.

To build up hard gold plating half a tenth for sliding contact near 0.1 in. from the end(s) without over-dogboning, the ends will need to be removed. This can be done by anodic or acid etching. Be careful that the material isn't a high carbon type, which would leave a graphite-enhanced, hard-to-plate surface. The metal removal is intended to round off the ends such that when pulse-enhanced dogbone plating occurs, you will end up with original geometry plus half a tenth hard gold in the right place. There should be less gold in the middle, but at the end edges there will be a greater thickness of gold. If your intention was to have less gold consumed, this would be the best you could get for the least effort. If there were bumps at the ends, sliding fits would be ensured.

To get the maximum current density for an end-throw effect, the bath should operate at the high end of gold concentration. Make sure that the ratio of gold to brightener (cobalt hardener) allows you to run at the lowest pH, where more conductivity allows more gold plating for longer pulse on times. The maximum current density should be balanced with the length of pulse time on. When either one is exceeded, plating will be manifested by burning at the ends. When this occurs, either reduce current density or pulse time on.

I suggest optimizing the solution composition first, then the plating configuration (*i.e.*, barrel loading parameters for large current incursions). The plating on and off times need consideration. On times will probably work from 10 to 50 msec, depending on the current density usable. Less time can accommodate higher current density, while a longer on time is suitable for lower current density. The length of pulse off time should, for your purposes, be at the lower end of the range of 1–3 to 10–15 msec.

A recent report* used a 10 oz/gal diammonium citrate, ammonium sulfate and 20,000 ppm gold (PGC) to give your desired dogboning results, in descending order:

ON	OFF	%duty
4	2	66
8	4	66
8	80	9
2	1	66

Best Regards, Steve
P&SF

* Rehrig, D.L. & N.V. Mandich, *Plat. & Surf. Fin.*, Dec. 1999, pp. 89-93.