

Tech Talk

Fine Lines in High Yield (Part CXXXI)

Compatibility of Different Resists in Developer Chemistry

Karl H. Dietz (for CircuiTree Magazine, August, 2006)



Karl Dietz is the manager at DuPont's Electronic Materials Laboratory, Research Triangle Park, NC. His responsibilities include application studies for printed circuit materials. Karl has 35 years of experience in a variety of R&D, manufacturing and quality control functions and holds a PhD. in organic chemistry from the University of Frankfurt, Germany. If you would like to participate in the exchange or if you have any questions, Karl Dietz can be reached at 919-248-5248, fax: (919) 248-5132, or via e-mail <Karl.h.dietz@usa.dupont.com>.

If a PWB fabricator processes different dry film photoresists through the same developer machine and chemistry, the question about "compatibility" of the different resists usually comes up. So there needs to be a methodology to assess compatibility. This in turn raises the question what are the signs of incompatibility, what problems might incompatibility cause, and how should we measure or quantify the degree of incompatibility.

In a specific example we assessed the compatibility of a general purpose dry film resist with a plating resist. Potentially, there could be more than one sign of incompatibility to be worried about. For example, the developer chemistry at a given resist loading might be more prone to foaming if the total loading is made up of dissimilar resists. But the more prevalent concern is the formation of gummy precipitate ("gumming") in the developer. Such gummy precipitate may not filter well, could deposit on transport wheels, and redeposit onto the panel surface, causing shorts in a print & etch process, especially on very fine circuitry boards. The correlated defects in pattern plating might be opens and copper/copper peelers.

It is not obvious why certain resists are compatible and others are not. It has been suggested that the solubility curves of incompatible resists show a stronger "common ion effect" (i.e. "salting out" effect) than those of compatible resists.

Test details:

Developer solutions with 12 mil-sqft/gal resist loading were made up separately. Six sqft of the 2 mil thick plating resist were developed in one gallon of 0.85% (anhydrous) sodium carbonate at 30 degrees C (see illustration of Figure 1). Likewise, 6 sqft of the 2 mil thick general purpose resist were developed in one gallon of 0.85% (anhydrous) sodium carbonate at 30 degrees C. The appearance of the developer solution was recorded and a picture taken. There were no signs of gumming. The solutions were checked again after one day and the appearance was recorded. There was no sign of gumming. Then 5 cc of antifoam were added to each solution and the solutions were inspected for signs of turbidity, precipitation, or gumming. This inspection was repeated after one day. No signs of gumming were detected. Then a 50/50% mix of the plating resist and general purpose resist developer solutions was created by combining ½ gallon of each solution to obtain one gallon of mixed solution. Again, the combined solutions were checked for signs of precipitation and gumming. This was repeated one day later. No gumming was noted leading us to the conclusion that these two resists are compatible.

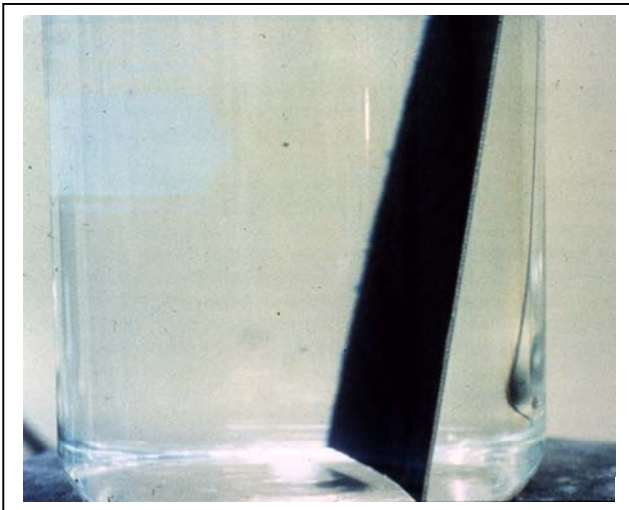


Figure 1: Resist Covered board in Beaker at the Beginning of the Development Process.

The issue of resist incompatibility in development has become less of a problem in large PWB shops with dedicated develop/etch/strip lines in which only one type of resist is processed. If more than one resist is processed through the same developer and there is concern about incompatibility, one should go through the typical developer clean-up procedure that many shops practice once a week before switching over to the other resist. If the cause of gumming is the "common ion salting out effect" then one might consider a mixture of sodium and potassium carbonate as the active developer replenishment, but this is an unwelcome complication of the process. If the above described developer

compatibility test shows some gumming after the anti-foam addition, then we may not have a case of resist incompatibility but a case of incompatibility of the resist with the anti-foam. In this case one might consider the use of a different anti-foam or the use of less or no antifoam. Several modern developer chamber designs minimize foam formation, so one should not automatically assume that anti-foam is needed in a new developer machine.



The miracles of science™