ETCHANT RINSE METHOD

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ABSTRACT

Residual etchant, such as acid and the like remaining
on articles such as printed circuit boards that have
been etched, contains a metallic chemical component,
such as copper. When this residual etchant is rinsed
from the articles (such as printed circuit boards), it
contaminates the water of the rinse. The chemical re-
placement of copper ions in the rinse with aluminum
ions by passing the rinse through a basket filled with
aluminum turnings, and recycling the rinse thus passed
back for reuse at the rinsing station continuously ren-
ders the rinsing water free of copper, to permit peri-
dodic discharge of the rinse water to sewage or the like.

4 Claims, 2 Drawing Figures
ETCHANT RINSE METHOD

This is a division of application Ser. No. 190,136 filed Oct. 18, 1971.

BACKGROUND OF THE INVENTION

In the art of etching printed circuit boards and the like, it has been commonplace to rinse acid etchants from the printed circuit boards, for purposes of "cleaning" the acid from the boards, in order that the boards may be subsequently handled by personnel, and also to assure the termination of the etching process, on copper components of the board. Such washing or rinsing has conventionally been done by spraying the boards with a water rinse, and either continuously or periodically replacing the water rinse with used water rinse being discharged to sewage or the like. However, such used water rinse in accordance with the abovementioned prior art techniques has contained copper ions therein, and such has been found to cause undesirable ecological effects upon streams, waterways and the like, into which the used rinse eventually finds its way from sewage.

Furthermore, the copper contained within the acid rinsed off the boards in accordance with these prior art techniques has been permanently lost.

SUMMARY OF THE INVENTION

The present invention is directed toward providing an apparatus and method whereby recycling of the rinse water is possible without building up an undesirable level of copper concentration in the rinse water, and whereby the rinse water is not contaminated by copper, so that the same may be discharged into conventional sewage lines, streams, etc., without producing damaging environmental effects. A portion of the rinse water being delivered to spray nozzles passes from the reservoir of rinse water to and through a particular material (preferably aluminum turnings), and the rinse water is dispersed therethrough, eventually being returned to the rinse reservoir. During its passage through the aluminum turnings, a chemical replacement of copper ions in the rinse is effected, by replacement with aluminum ions, with the copper ions being reduced to metallic copper, and with the aluminum being oxidized and flowing into solution in the rinse water. The rinse water thus accumulates an aluminum ion concentration, which may periodically be discharged as desired, without producing undesirable environmental effects.

Accordingly, it is a primary object of this invention to provide a novel method of treating etchant rinse water.

It is a further object of this invention to provide a novel method of replacing copper ions in etchant rinse water with aluminum ions.

It is another object of this invention to provide a novel apparatus for rinsing etchant reactants from articles that have been etched, wherein such apparatus involves chemical replacement of unwanted metallic ions in the rinse medium.

Other objects and advantages of the present invention will be readily apparent to those skilled in the art from a reading of the following brief descriptions of the drawing figures, detailed description of the preferred embodiment, and the appended claims.

IN THE DRAWINGS

FIG. 1 is a transverse sectional view through the several components of a rinsing apparatus of this invention.

FIG. 2 is a longitudinal sectional view through a portion of the rinsing apparatus illustrated in FIG. 1, and illustrating the manner in which the rinse is sprayed onto printed circuit boards or the like passing through a rinse chamber from an etching chamber or the like.

Referring to the drawings in detail, reference is first made to FIG. 2, wherein an upstream chamber 10 is illustrated, as comprising an etching chamber, or if desired, a chamber for first physically removing etchant from printed circuit boards 11 or the like conveyed therethrough, by means other than water spraying. The printed circuit board 11 for which this apparatus has been developed, is then delivered into a rinsing chamber 12, passing along a plurality of driven rollers 13, which rotate in a clockwise direction as viewed in the illustration of FIG. 2, for movement of the printed circuit board 11 in the direction of the arrow 14 of FIG. 2, through the chamber 12 for eventual discharge through the outlet 13 thereof, to a driving station or the like.

The board 11, upon its delivery to the chamber 12 may have residual components of an etching acid, such as ferric chloride thereon, that has been used to etch unmasked copper portions of the printed circuit boards, and such residual etchant thus contains a certain copper content.

The board 11 then passes between upper and lower sets of spray nozzles 15 and 16, that are supplied with water under pressure, for spraying the board 11 through a certain zone such as that indicated in FIG. 2, with the zones of spray of the nozzles combining transversely of the machine, in order to completely spray a board 11 carried therewith, as will be more clearly apparent with reference to the illustration of FIG. 1.

The upper spray nozzles 15 are connected to rinse water header 17, and the lower spray nozzles 16 are each connected to a lower rinse water header 18, with the headers 17 and 18 being supplied with rinse water from a common delivery line 20. After spraying of the board 11 with rinse water passing through the nozzles 15 and 16, the rinse water 21 drops into a reservoir 22, and such rinse water 21 and the reservoir 22 now has a slight concentration of copper ions therein. Rinse water 21 is delivered from a chamber 22, by a pump 23, or other suitable device, which receives the rinse water 21 at a lower inlet 24 thereof, and delivers the same through an outlet line 25, with the pump 23 being driven by an electrical motor 26 or the like disposed outwardly of the chamber 22, but connected to the pump 23 through a rotatable shaft 27 that passes into the chamber 22 from outside thereof, to drive the submerged pump 23.

Rinse water is thus delivered through the line 25, outwardly of the chamber 22, with the delivery line 25 being bifurcated at the piping tee 29, with some of the rinse water being delivered to the spray nozzles 15 and 16, through the line 20, and some of the rinse water being delivered through a replacement chamber 28, and back into the reservoir 22 through a return line 30, selectively openable upon actuation of a switch 31 or the like, as desired, whereby rinse water is delivered to the replacement chamber 28, as a parallel loop to that
delivered to the spray nozzles 15 and 16. Thus, rinse water enters the replacement chamber 28, being delivered thereto by a suitable piping line 32, and passing through a generally open shut-off switch 33, entering the replacement chamber 28 through the bottom 34 thereof, at a central opening thereof, for passage outwardly of a plurality of holes 35, or other suitable perforations in the outer surface of a hollow cylindrical upstanding standpipe 36, as illustrated in FIG. 1.

The turbie tank 37 is provided, inwardly of the replacement chamber 28, the bottom of which has a blind hole therein for facilitating the disposition of the tank 37 over the standpipe 36, and with the sides of the blind hole 38 in the tank 37 for facilitating the passage inwardly of rinse water into the interior 40 of the tank, as such rinse water passes through perforations 35 of the standpipe 36. The tank 37 is constructed as a basket, with the outer cylindrical surface 41 thereof also being perforated, and with the basket being filled with a particulate material such as aluminum turnings whereby the rinse water 21 delivered through the line 32 will pass through the aluminum turnings, to be discharged through the tank 37, but passing through perforations in the outer wall 41 thereof. It will be noted that the outer surface of the tank 41 is spaced inwardly of the inner surface of the chamber 28, to form an annular void therein, for passage of water upwardly, inasmuch as the water is under pressure from the pump 23, and with the water thus being delivered through the line 30 as aforesaid, into the chamber 22.

The turbie tank 37 is also provided with a handle 43 whereby the same may readily be grasped and removed from its position over the standpipe 36, upon opening the lid 44 of the chamber 28, whenever the concentration of copper within the aluminum turnings necessitates replacement of the tank 37, or of the turnings carried therein.

It will be apparent from all of the foregoing, that during the passage of the rinse water through the aluminum turnings within the tank 37, the dissolved copper content within the rinse water is chemically replaced with aluminum from the aluminum turnings, and the copper ions removed from the rinse are reduced to metallic copper and is oxidized, going into solution in the rinse water. The water reservoir thus remains extremely low in copper ion concentration, but will progressively increase in aluminum ion concentration. Upon the reservoir 22 achieving an objectionable level of aluminum ion concentration, the rinse water 21 therein may be discharged to sewage or the like, without causing contamination of sewage lines, waterways, or the like.

The herein discussed invention is significant in that it provides a simple and low cost means of eliminating objectionable copper ions from etchant rinse water. Accordingly, a highly desirable anti-pollution feature is encompassed by the present invention, which replaces copper ion concentration in rinse water with more acceptable aluminum ions.

While displacement reactions themselves are previously known, for removing copper from solution generally, and wherein such processes are generally known as "cementation", in the mining industry, for example, the use of replacement ions to resolve a heretofore difficult pollution problem for the etching industry, and particularly for the industry relating to the etching of printed circuit boards is highly desirable.

It will also be apparent that other types of chemical replacement may be effected, in lieu of using aluminum particles within the tank 37. For example, iron fillings, magnesium, or any other metal above copper in the electromotive series, or any other substance that will effect the desired ion exchange, preferably with regard to its adaptability to achieving the other desired ends of this invention as set forth herein, may be utilized within the tank 37, if desired, for replacement of copper ions with iron ions in the solution.

Another feature of this invention is that the process permits continuous replacement of copper ions in the rinse water, by permitting continuous removal, by displacement reactions onto the aluminum surfaces of the particles within the tank 37. It will, however, be apparent that the parallel loop arrangement illustrated in FIG. 1 is not to be construed as limiting, in that rinse water 21 from the tank 22 may pass serially first to the tank 37, and then to the spray nozzles 15 and 16, if desired, or the converse.

It will be apparent from the foregoing that various modifications may be made in the details of construction of the apparatus of this invention, as well as in the method of use thereof, all within the spirit and scope of the appended claims.

What is claimed is:

1. A method of removing residual chemical etchant from articles such as printed circuit boards and the like that have been subjected to etching of copper portions thereof, comprising the steps of conveying etched articles along a predetermined path, spraying the articles with a water rinse during their conveyance along the path and thereby accumulating a significant concentration of copper ions in the rinse water, collecting the rinse water in a reservoir, providing a tank of particulate material, which material is capable of replacing copper ions in the rinse with its own ions, continuously delivering rinse water from the reservoir simultaneously to the tank for transfer through the particulate material wherein the ion replacement is effected and for spraying the articles, and continuously recycling rinse water that has been subjected to the ion exchange to the reservoir, for reuse in spraying.

2. The method of claim 1, wherein the particulate material comprises aluminum particles for replacement of copper ions in the rinse water with aluminum ions.

3. The method of claim 2, wherein rinse water delivered to the tank is pumped thereto from the reservoir concurrently with pumping of rinse water for spraying, through a common bifurcated delivery line, and wherein rinse water is delivered directly to the reservoir following the ion exchange.

4. The method of claim 1, wherein the rinse water is periodically discharged to a sewage line and replaced as the ion concentration of the replacing ions from the particulate material in the rinse water reaches a predetermined level.