PROCESS FOR CONTROLLING METAL ETCHING OPERATION

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FIG. 1

FIG. 2

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7 Claims

ABSTRACT OF THE DISCLOSURE

A method for controlling the rate of the solution of a metal in a commercial metal etching operation which comprises having a sample test bath of composition the same as the operating bath and in communication with it sampling the operating bath continuously and circulating the sample through the sample bath and continuously etching a continuously moving test metal sample in the test bath and optically measuring the rate of dissolution of said metal article and maintaining the end of solution of metal within two optically indicated points.

The present invention is directed to a process for controlling the concentration of etchant in metal etching solutions and to apparatus useful in said process.

Solutions in which metal is etched are being used on an increasing scale. Such solutions are primarily used in machining of metal by chemical means; in the manufacture of printed circuits in which the greater mass of the metal is dissolved away from the desired protected pattern; and in the production of printing plates. Industrial metal etching processes of this nature require close control of the etching rate to meet manufacturing objectives. Known methods for controlling the etching rate have been based upon measurements of one or more constituents of the metal etching bath. The constituent measured might be the bath component that accomplishes the oxidation of the metal. It might be a related component. The bath might also be controlled by measuring a constituent which enters the bath as a result of the metal etching process. To obtain rapid analysis and a maximum continuity of control, known methods have largely relied upon colorometric determinations. All such methods for controlling the metal etching solutions suffer from the disadvantage that they are based on measuring a bath component which is correlated to the metal etching rate. Unfortunately the correlations are not definitive. Often the actual metal etching rate is affected by variables which do not lend themselves to an accurate correlation. The actual etching rate is also affected by introduction of extraneous material into the bath. A need exists for a method for measuring the actual etching rate rather than by measuring something which, under specified conditions, as has been known to produce a particular etching rate. This is particularly important in large installations where automatic control of the etching operation is desired.

It is an object of the present invention to provide a method for controlling the rate at which metal dissolves in an etching solution.

It is a further object of the present invention to provide a method for controlling the concentration of metal etching solutions so that predetermined metal etching rates are maintained.

It is also an object of this invention to provide apparatus operative in the foregoing process so that control will become apparent from the disclosure and drawings herein in which
up spool 18. Take-up spool 18 is a constant-speed capstan driving device and take-up spool combined. The shaft 24 of the spool is the driving device. It is driven by a slip-clutch drivewheel working indirectly from a motor. The device provides a constant linear speed drive. The mechanisms for drives and spools of this type are similar to those used in commercial tape recorders. The wall 16 of the control unit 7 is manufactured of an opaque material such as black polymethylmethacrylate plastic or stainless steel and contains a window 19, about six inches long and one-eighth inch wide manufactured from a transparent material, i.e. clear polymethylmethacrylate, which is positioned adjacent the travel of the copper-tape 11. Photoelectric cells 20 and 22 are positioned outside the window. Each of these cells carries a mask about two millimeters by two millimeters. A bright light source 21 is positioned in the control device so that a bright beam of light is directed through the window 19 to photoelectric cells 20 and 22, each of which is positioned alongside of window 19. The rate of speed of the copper-tape 11 is correlated so that in the desired operation of the control unit, the copper metal is entirely dissolved when the tape passes that portion of the window through which light falls on photoelectric cell 22. If the etching solution is overly concentrated, the copper dissolves more rapidly than is desirable. The copper will have all dissolved from the copper-tape 11 at a point before the tape arrives at the photoelectric cell 20 causing light to fall with high intensity on photoelectric cell 20. When this occurs photoelectric cell 20 operates and through an electric control system actuates automatic etch reagent regulator 5 to decrease the flow of etching reagents to the etch tank 1. When the etching solution contains an insufficient amount of etching reagent, the rate of metal dissolution will be less and all the copper from copper-tape 11 will not be dissolved when the tape passes photoelectric cell 22. When photoelectric cell 22 receives less than the usual amount of light, a relay is actuated which directs automatic etch reagent regulator 5 to increase the flow of etching reagents to etch tank 1.

The control of the rate of etching in the manufacturing operation in the apparatus of the example is by automatic etch reagent regulator 5. Control of the etching rate may be affected by control of any of the etching process variables. Thus, in the system illustrated, control of the rate of flow of etchant to the solution is maintained by the automatic etch reagent regulator. This may be accomplished in a single etching line or a multi-stage etching line. Control of the etching rate may also be accomplished by controlling the temperature of the etching bath. Modern etching lines utilize direct spray of etching solution upon the part being etched. Control of the rate of etching may also be maintained by controlling the pressure behind the spray heads. In batch operations, the control unit may be used to regulate the transport of laminates through the etching machine so that the laminates are removed promptly when etching is completed to avoid underetching. The process of this invention may be used to control the etching rate by controlling any of these variables or any combination of them to attain the desired result.

The control unit is manufactured from materials which are resistant to the etch solution utilized. Preferred materials of construction are stainless steel and the plastics such as polymethylmethacrylate.

Although the invention has been described in connection with specific embodiments, it is to be understood that it includes all modifications and variations that come within the scope of the appended claims.

What is claimed is:

1. The method for continuously determining and controlling the rate at which metal is dissolved in an operating commercial metal etching bath comprising contacting at least one metal test article identical to metal being etched with sample etching solution taken from said metal etching operation to a separate test bath in liquid communication with said operating bath and continuously measuring the rate of dissolution of metal test article in said sample etching bath whereby the etching rate of said etching solution is determined directly by disappearance of said metal test article and adjusting the concentration of said etching solution in accordance with the results of said etching rate determination.

2. The method of claim 1 wherein said metal test article is in the form of a continuous strip of metal and wherein said continuous strip of metal is of the same metal as that in the metal etching operation being controlled.

3. The method for continuously controlling the rate at which metal is dissolved in a commercial metal foil etching bath comprising

(i) continuously sampling and passing etching solution being used in said metal etching bath through a control unit passing a plastic tape having some of said metal foil laminated therewith said etching solution in said control unit at a predetermined rate,

(ii) optically measuring the point of disappearance of said metal foil in said control unit, and

(iii) using the results of said measurement to control the concentration of said etching solution in said etching bath.

4. The method of claim 3 wherein the rate of dissolution of said metal foil is measured by determining the point at which said metal foil is completely dissolved from said tape.

5. The method of claim 4 wherein said plastic tape is transparent and wherein the combination of a light source directed across the path of travel of said tape in combination with at least one photoelectric cell is utilized to determine the point at which said metal foil is completely dissolved from said tape.

6. The method of claim 4 wherein said metal is copper and wherein said etching solution is an aqueous solution containing as solutes therein, about 10% to 45% of a persulfate and a catalytic amount of ions of a metal having an electrode potential more negative than the electrode potential of copper.

7. The method of claim 5 wherein said metal is copper and wherein said etching solution is an aqueous solution containing as solutes therein, about 10% to 45% of a persulfate and a catalytic amount of ions of a metal having an electrode potential more negative than the electrode potential of copper.

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