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METHOD OF ETCHING AND PLATING UREA FORMALDEHYDE

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ABSTRACT OF THE DISCLOSURE

The surface of a urea-formaldehyde article is minutely roughened by immersion in an aqueous solution containing a major portion of formic acid and a minor portion of hydrochloric acid. The roughened surface is then plated to form a strongly adherent metal coating.

Disclosure of the invention

This invention relates to the roughening of plastics with acid as a pretreatment prior to metal plating. The invention is primarily concerned with the electroless plating of metal on condensation polymers such as urea-formaldehyde.

Certain metals do not adhere well, either by chemical or physical interaction, when coated on certain substrates. It appears to be generally true that conductive metals have only weak affinity to non-conductive plastics, such as urea-formaldehyde.

The prior art has found it necessary to roughen non-conductive plastics prior to metal plating. The roughened surface apparently presents minute extensions which extend into a metal coating subsequently applied to mechanically lock the metal coating to the non-conductive plastic.

One common method of roughening for this purpose is grit blasting. Grit blasting is analogous to the commonly known technique of abrading surfaces by sand blasting. Grit particles impact the surface with sufficient kinetic energy and rigidity to deform and thus minutely roughen the surface. Grit blasting is effective, but it requires expensive equipment and constant control to assure a grit spray which will not over-roughen the plastic surface. The initial cost of equipment and the constant expense of controlling the potentially excessive grit blasting process thus render grit blasting undesirable for some applications.

It is an objective of this invention to provide a roughening process for urea-formaldehyde which avoids the use of grit blasting equipment.

It is a further object of this invention to provide a roughening process for urea-formaldehyde which requires relatively inexpensive materials and equipment.

It is a still further object of this invention to provide a roughening process for urea-formaldehyde which is capable of use in volume production without critical control and critical monitoring of the parameters of the process, although, of course, reasonable control and monitoring of the process will be necessary.

Acid roughening of plastics for this purpose is known in the prior art. This invention is an acid roughening process, but it is believed that this invention for the first tme teaches the proper formula and utilization of that formula.

In accordance with this invention, a thoroughly cured urea-formaldehyde resin is roughened prior to metal plating by immersion in a solution containing a major part of formic acid and a minor part of hydrochloric acid.

The foregoing and other objects, features, and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention.

The item to be processed in accordance with the preferred embodiment of this invention is a light, spherical, truncated ball carrying the images of an entire alphabet of characters in the form of raised salients. The ball will be used as the print element of a typewriter or printer. The ball is rotated and tilted by the mechanisms of the printer to select the proper character on the ball. The ball is then impacted into a print station to effect printing. Printers using such a ball are now well known in the art.

The ball is molded under heat and pressure to form a resinous solid essentially comprising urea-formaldehyde resin, alpha-cellulose filler, pigments, and plasticizers. The urea-formaldehyde is a major structural component and the entire ball bound together by the urea-formaldehyde must be acted upon if effective, minute roughening is to be accomplished. Also, excess roughening must be avoided if the image definition of the character salients on the ball is to be preserved.

In accordance with this invention a molded ball as described is immersed in a solution of a major part by weight of formic acid and a minor part by weight of hydrochloric acid. Specifically, the preferred formula is 75 parts of an aqueous solution containing about 88% by weight formic acid, mixed with 25 parts of an aqueous hydrochloric acid solution containing HCl within the limits of 36.5% to 38.0% by weight. The solution is thus about 66 percent by weight formic acid and about 9.3 percent by weight hydrochloric acid.

Upon removing the ball and cleaning in any suitable manner, such as washing in water, the urea-formaldehyde is minutely roughened in a form exceptionally suitable for metal plating for subsequent use as a typing element. The ball is not unduly roughened as is true with other acid etch processes examined. By minutely roughened is meant a condition at which strong adhesion of a metal film is attained, but the eye cannot significantly discern roughness in the edges of a character printed from the metal coated ball.

The time of immersion is not critical, it being easily determined by routine experiments to achieve a suitable degree of roughening. Small variations in time of immersion do not produce close tolerances or unexpected results. Depending on the various factors herein discussed, the time of etch varies within the order of magnitude of five minutes.

The degree of curing of the ball, however, must be carefully considered in practicing this invention. For purposes of describing this invention, it will be said that the invention is operative when used with thoroughly cured urea-formaldehyde.

Curing is accomplished with the application of heat and pressure to the mold containing the basic components of the ball. The molding powder used is Plaskon SM, a product of Allied Chemical Corporation. It contains the base materials which coact to form a urea-formaldehyde resin and also contains the alpha-cellulose filler, pigments, catalysts, and plasticizers as significantly important compounds. The mold used is a hollow form of the truncated ball with extending salients in the form of raised type dies.

Factors in molding and curing the ball differ to the extent that time limits can not be usefully specified except for a definite type of mold machine and environment. Instead, one skilled in the art practicing this invention should consider the following facts and then adjust the temperature, pressure, and durations to conform to the factors. Both overcuring and undercuring results in a resinous

article which tends to be greatly roughened by the etching bath of this invention, even during short immersion durations. Overcuring may mean that the polymers involved have been degraded by the extreme environment, and overcured spots can be observed visually without special equipment. In accordance with this invention it is also important that the type ball is thoroughly cured, without the high percentage of unreacted monomers characteristic of an undercure.

The thorough cure needed is best defined by the degree of roughness obtained by the acid etch. A molded article is etched in accordance with this invention and the surface characteristics obtained are observed with a profilometer. A Micrometrical Manufacturing Company of Ann Arbor, Mich., Type QC Amplifier, profilometer has been used, and the proper roughness is defined by profilometer readings 25 ± 5. A profilometer is a test instrument which actually traces the surface of an article with a needle like member and registers the changes on a gauge. Steep sides on the minutely roughened surface are also important for the metal plating purpose, but these are inherently provided by the acid etch of this invention.

The gauge numbers on the profilometer used are believed to be standard scales found in most profilometers regardless of manufacturer. A proper, thorough cure in accordance with this invention may also be determined by observing the adhesion and smoothness of a metal layer subsequently applied. Whether a profilometer or other tests are used, the degree of curing should be established by such tests and then controlled during quantity production since proper roughening in accordance with this invention appears to require a cured urea-formaldehyde within limits which are not necessarily characterized by observable undercuring or by degradation due to overcuring.

The subsequent metal plating in this preferred embodiment is as is now known by the art. The roughened plastic is pre-sensitized by immersion in a bath which deposits catalytic amounts of stannous ions. A subsequent immersion in palladium ions deposits a continuous layer of palladium onto the material. Further electroless and electrolytic plating steps may be conducted to bring the metal layer up to the thickness desired. Another metal, such as preferably nickel, may be plated over the palladium.

We claim:

1. A process to roughen and then metal plate an item comprised of a thoroughly cured polymer of urea-formaldehyde comprising the steps of:

immersing said item with a bath consisting essentially of a major part by weight of formic acid, a minor part by weight of hydrochloric acid and the remainder water for a time sufficient to minutely roughen said item, such that the surface roughness when measured by a profilometer gives a reading of 25 ± 5, and

subsequently metal plating said item.

2. The process of claim 1 in which said item is a printing element carrying at least one character in the form of a raised salient.

3. A process to roughen and then metal plate an item comprised of a thoroughly cured polymer of urea-formaldehyde comprising the steps of:

immersing said item with a bath consisting essentially of about 66 percent by weight formic acid, about 9.3 percent by weight hydrochloric acid and the remainder water for a time sufficient to minutely roughen said item, such that the surface roughness when measured by a profilometer gives a reading of 25 ± 5, and

subsequently metal plating said item.

4. The process of claim 1 in which said item is a printing element carrying at least one character in the form of a raised salient.

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