Introduction of Aqua Plasma Boost® and AQ-2000BT: Excellent for Reducing Large Sized Samples of Oxidized Copper

New Business Development Division, Samco, Inc.

Introduction

Samco focuses on product development with an emphasis on environment, health and safety (EHS). We have been advancing research on water vapor plasma at low pressure, Aqua Plasma® [1], and product development using this treatment method. H, O, and OH radicals are generated in the plasma, and reduce oxidized copper or silver electrodes, remove organic residue, and make the surface superhydrophilic. This method is widely used in semiconductor back-end processes such as wire bonding and molding on lead frames. Its applications have included reduction of electrodes, cleaning of organic residues, and hydrophilization to improve wettability or adhesion. Nowadays, the Aqua Plasma® has expanded to front-end processes such as descum process to remove photoresist residue on the copper electrode prior to plating. Moreover, the range of applications has expanded to include ø12″ wafers. However, it had an upper size limit for reducible oxidized copper.
This report introduces Aqua Plasma Boost® newly developed to reduce large sized samples of oxidized copper and the system AQ-2000BT.

Aqua Plasma Boost® and AQ-2000BT

Aqua Plasma Boost® enhances its reduction performance by using reducing gas in addition to water vapor (patent pending). It also has excellent organic matter decomposition and hydrophilic effects as shown in Figure 1(a). Figure 1(b) shows the appearance of AQ-2000BT connected to a booster. The reducing gas is produced by the booster in the required quantities. The booster and the reducing gas are easy to handle and safe to use.
AQ-2000BT supports large diameter wafers and large size substrates with copper electrodes. In addition, production batch and magazine processing are also available (Figure 2).

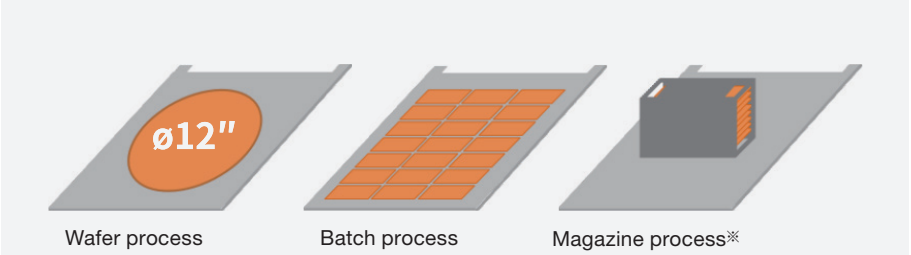
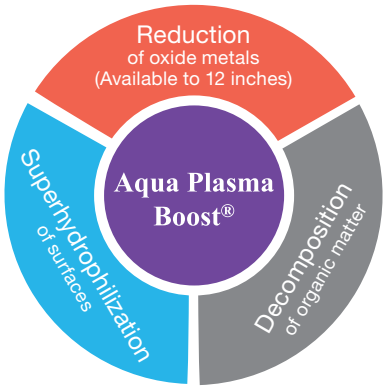


Figure 2. Available sample set types of Aqua Plasma Boost®



(a) Effects of Aqua Plasma Boost®

(b) AQ-2000BT

Figure 1. Aqua Plasma Boost® and AQ-2000BT

Reduction Performance

Reduction performance of Aqua Plasma Boost® was evaluated using a ø12″ copper plate oxidized to a depth of 40 nm. A previous study [2] reports that the copper color changes with the thickness of the oxide film and oxidized copper can be reduced to a depth of about 200 nm based on XPS analysis and SEM cross-sectional observations. Because the copper oxide layer is thinner than 200 nm, it is considered possible to determine whether the reduction is appropriate or not based on the color change.
Aqua Plasma® could not reduce the oxidized ø12″ copper plate, whereas Aqua Plasma Boost® completely reduce it(Figure 3). The reduction time was 3 minutes.

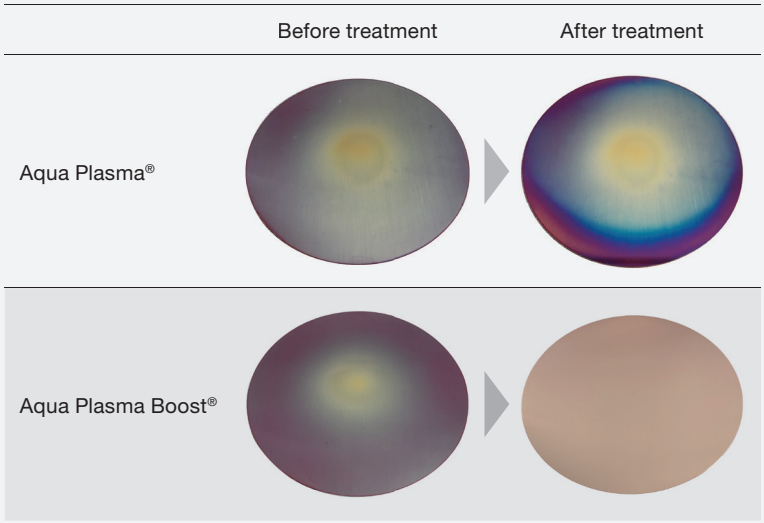


Figure 3. Appearance change of oxidized ø12″ copper plates

Decomposition and Superhydrophilization

Aqua Plasma Boost® can decompose photoresist or organic residue on copper surface simultaneously in the reduction process. During the 3 minutes process, approximately 30nm of photoresist is expected to be removed. This amount satisfies typical requirements for post-process cleaning and descum processes. In addition, many types of photoresist surface are superhydrophilized with contact angles below 10°. Therefore, this method is also expected to improve adhesiveness of mold resin and wettability of plating solutions.

Postscript

AQ-2000BT has a more detailed introduction and demonstration system. Wafer transfer type can also be manufactured. Feel free to contact us if you have any questions.

■ References

[1] SAMCO NOW Vol. 94, 96, 100, 102, 107, and 111

[2] H. Terai, et al. Reduction of Copper Oxide by Water Vapor Plasma at Low Pressure IEEJ Trans. Sensors Micromachines 139, 157-162 (2019). 11-14, 2019.

Samco Inc.
For more information please email: info@samco.co.jp URL: https://www.samco.co.jp/en/