DEVELOPMENT OF A DOUBLE LAYER SPRAY/SPIN COAT PROCESS FOR IMPROVING COAT UNIFORMITY OF AN 80 MICRON COAT PROCESS

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Abstract:

To achieve an 80µ coat thickness with a photo definable epoxy it has been necessary to do a double layer coat. The original process was set up to use a spin coat - post coat bake sequence followed by another spin coat - post coat bake sequence to obtain the target resist thickness. The main problem with this process is uniformity control. To improve uniformity control a process flow using a spray coat – post coat bake sequence followed by a spin coat – post coat bake sequence was developed.

Introduction

As part of a wafer level packaging process, a process by which cavities with walls of photo definable epoxy are created that are approximately 30µ wide and 80µ tall. In order to produce these walls it is first necessary to coat the wafers at the target thickness with good uniformity.

Good uniformity is necessary for several reasons. These include having consistent height so that the bonding operation has enough room to work properly and the ability to print the pattern using a proximity print method without having areas where the mask contacts the surface of the epoxy and causes defects.

The original coat process that was developed consisted of a spin coat – post coat bake sequence to coat an initial ~40µ of the epoxy followed by another spin coat – post coat bake sequence to coat an additional ~40µ of epoxy for a total final coat thickness of ~80µ. This process was performed on an EVG150 coater using IDI610 pumps and in a closed bowl environment. The uniformity achieved with this process was approximately ±7%. The major forms of non-uniformity in this process are a thick area in the center of the wafer and a thick edge bead.

The thick area in the center is a result of dispensing directly in the center of the wafer with a very viscous material (~13,000 cSt). The material dries fairly rapidly even in a closed bowl environment and requires a relatively slow spread spin speed. In addition, the material tends to build up at the edge of the wafer and even migrate toward these build ups during the post coat bake process.

Initially, it was planned to go to a spray coat process to build the entire 80µ thickness. Some issues were found with this. It was decided at that point to attempt to achieve better uniformity using a combination of spray and spin coat processes.

This paper will discuss the equipment and methodology used for developing this process and the results measured in the ability of the new process to produce better coat uniformity on a wafer.

Equipment

The equipment used for this process development was EVG150 coater/developer systems. The EVG150 utilizes an ultrasonic vortex nozzle fed by an IDI 450 pump (or automated syringe system) for spray coating and a tube nozzle fed buy an IDI 610 pump for spin coating.

The system has “closed bowl” capability so that during the spin out operations a lid can be lowered to seal the bowl and create a solvent rich environment. No top side dispenses can be performed with the bowl closed.

Methodology

Initial tests were performed at the EVG facility in Tempe.

Standard photo definable epoxy was hand diluted using a mixture of MEK and PGMEA. The diluted mixture was dispensed using an automated syringe dispense system to feed the ultrasonic nozzle. This was used to spray coat the first layer for the ~80µ total stack. A shortened Post Coat Bake (PCB) process using a single hotplate was utilized. The spin coat process uses a three stage bake using three hotplates.

As more wafers were processed to try to determine repeatability of this process, bubbles in the surface of the resist became an issue. Variations in the dilution and PCB processes were attempted in an effort to get rid of these bubbles without success. It was determined that the issue was with a bad vortex nozzle.

Two wafers with the first layer spray coat were sent back to TriQuint Texas and the second spin coat was successfully applied. At this point, all testing was moved to the TriQuint Texas facility. Factory diluted samples of the photo definable epoxy were obtained from the supplier.

The testing done at TriQuint was performed on an EVG150 system with two coat bowls. The first coat using the spray process was done in one bowl, the PCB for this was done, and then the spin coat was done in the second bowl followed by its associated PCBs.

Results

For the initial spray coat tests performed at EVG, final thickness for the spray coat was 30 to 35µ with a uniformity of ±10%. When two of these wafers had the spin coat applied at the TriQuint Texas facility, a total stack thickness of 70µ was achieved with a uniformity of ±7.8%. A baseline test processed at the same time using the double spin coat process produced a thickness of 79µ with a uniformity of 6.3%. The characteristic double center hump seen on the double spin coat processes was eliminated on the spray/spin coat wafers but the edge bead was worse.