Thick Film Photo Resist Application
Spun on Application v Dry Film Lamination

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ABSTRACT

As the success and functionality of smart phones continues to grow around the world, miniaturization of electronic components remains one of the main trends in mobile communications[1] **Wafer Level Packaging (WLP) continues to be a significant area of interest for RF front end module makers such as TriQuint. The possibilities to shrink dies sizes and simplify the packaging process can amount to a significant cost saving; this can be of strategic importance in a market where price competition is fierce.**

WLP processes are evolving, from flip chip capability to 3 dimensional cavity formations at the wafer level. Many of these processes require thick film photo resists and epoxies as part of the process flow. The standard photolithography process, where photo resist is spun onto the wafer, has made strides to accommodate this trend. However, in this process development space dry film photo resists are emerging as an attractive alternative [2]

This paper will discuss the development of an electroplating process; the author will compare a spin on photolithography solution with a dry film photolithography solution. The paper will compare process flows, process development challenges, capacity and cost comparison for each approach.

INTRODUCTION

Wafer level packaging (WLP) of SAW filters at TriQuint Florida is driving the requirement to use thick film photolithography materials. Conventional spin on photo resist is common place and has been used as the process of record in developing many of the WLP solutions. When coating films of thicknesses up to100um there are many process and manufacturing challenges; film thickness and uniformity control, wafer throughput and material costs. In this area dry film resists are emerging as an attractive solution. In this paper we will compare a parallel development effort to establish an electroplating process using a spin on material compared to a dry film laminated material. We will focus on the process flow comparison and the resulting process challenges. Wafer throughput and wafer cost comparisons will also be discussed.

PROCESS FLOW COMPARISON

Spin on photo resist application is a common practice in every wafer fab. When coating film thicknesses of 100um, achieving this in a single coat process becomes extremely difficult while maintaining repeatable and uniform coatings. In this application a double coat and bake sequence is used along with an intermediate edge bead removal step to allow for a planar resist coating. While this approach is successful the drawback is most certainly the efficiency of the resist coat process; the coating process itself is a main bottleneck taking anywhere up to 3 hours per lot. Exposures are longer for thick film resists, using a chemically amplified negative tone resist enables faster exposure times when compared to those of a positive tone material. Extended bakes are required to drive off residual solvents in the film.

In the case of dry film lamination however, the 100um thick resist is purchased by the roll. The film is directly applied to the wafer using hot roll lamination. The result after lamination is a uniform thick coat which requires no ancillary solvent processing or lengthy wafer bakes.

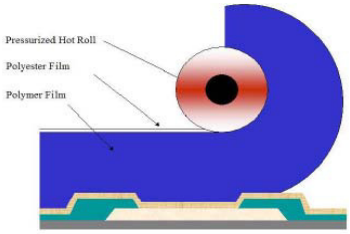

Figure 1: Dry film application using hot roll lamination

Various types of dry film resist and dry film laminator tools are commercially available. Depending on the process, the temperature, pressure and laminating speeds will control the throughput and quality of the resulting coat.
Lithography processing will be discussed in more detail.

CHALLENGES IN PROCESS DEVELOPMENT

Once the lithography pattern is resolved, both resists produce a consistently vertical sidewall, which is of significant importance in this process development.

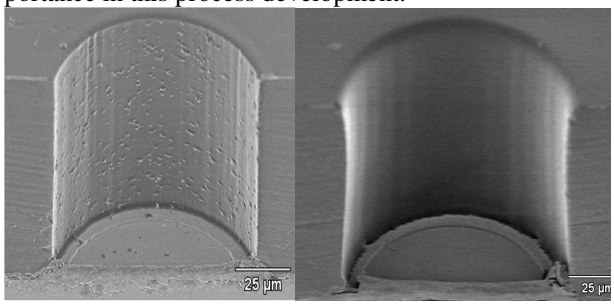

Figure 2: Resulting photoresist via with dry film photoresist compared to spin on photoresist

Beyond the lithography cell, the process flow for both resists will be identical for electroplating, resist stripping and field metal etching.
Process marginalities will be discussed.

WAFER PROCESSING COST

For the thick film photolithography, the biggest cost is in the photoresist and developer chemical consumption. While these numbers are process specific, they indiacate that raw material costs have potential to be significantly lower with the dry film laminated resist approach.

Materials Expenses (per wfr)	**Laminated**	**Spin On**
Photoresist	$4.00	$12.00
Developer	$0.12	$2.00
Total Materials expenses	**$4.12**	**$14.00**

Spin on process cost assumes a double coating of photo resist using approximately 8cc per wafer and develop using MIF developer. The dry film approach assumes 200mm of tape is consumed for the processing of a 100mm wafer. The developer solution used in the laminated resist process is purchased by the gallon and diluted to 1% concentration.
Cost and capacity comparisons will be discussed further.

REFERENCES

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