MEETING THE FABRICATION CHALLENGES FOR BACKSIDE PROCESSING ON THIN SUBSTRATES WITH ULTRAHIGH DEVICE TOPOGRAPHY

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Abstract:

TriQuint manufactures devices on ultrathin substrates (100 µm) with ultrahigh topography (>80 µm). The development of a mounting process that enables thinning of the substrate to the required thickness for such devices is presented with consideration to critical process requirements including total thickness variation (TTV), grind thickness uniformity, damage removal, etch resistance, and electrical parameters.

INTRODUCTION

As wafer thickness decreases to 100 µm and thinner, manufacturing challenges arise. Ultrathin wafers in the 100-µm thickness range with ultrahigh topography (>80 µm) are less stable and more vulnerable to stresses, and the die can be prone to breaking and warping—not only during grinding but also at subsequent processing steps.

One of the major requirements of mounting ultrahigh device wafers to carriers is to protect the active device during the thinning process. Protection must be provided by means of a consistent process that meets tight total thickness variation (TTV) requirements across the stack. Previously, large volumes of mounting material have been required to protect these ultrahigh devices. Mounting materials can be quite expensive; therefore, reducing the amount of material used per wafer is key to minimizing cost. Methods for developing a process that uses less material while still meeting all of the basic requirements are presented.

BACKGROUND

TriQuint manufactures semiconductor devices that require thinning of the 6-inch device wafer to as thin as 100 µm while supporting over 80 µm of topology. TriQuint currently uses a material and process that require multiple coating and baking steps to sufficiently cover device topography. In an effort to reduce cost and simplify the mounting process, TriQuint has started collaboration with Brewer Science, Inc. A coating and bonding process has been developed which allows achievement of 100-µm post-grind substrate thickness and sufficiently covers TriQuint topography in a single coating step using a Brewer Science bonding material (WaferBOND® HT-10.10 bonding material).

Tests for feasibility were first conducted at Brewer Science using its equipment. These tests were then followed up with several additional sets of tests at TriQuint using Brewer Science bonding material and demounting solution while using TriQuint's processing equipment.

METHOD

For the initial demonstration, 10 product wafers and carriers were bonded and mounted at Brewer Science, with an additional 10 device wafers coated (but not bonded) at Brewer Science. The bonded pairs were returned to TriQuint for device wafer thinning to 120 µm. The unbonded wafers were bonded and thinned at TriQuint.

All bonded pairs were initially scanned for voids using the Sonix® Fusion® scanning acoustic microscope (SAM). The carrier identification number was used to track each pair in this state. Figure 1 displays one of the scans.

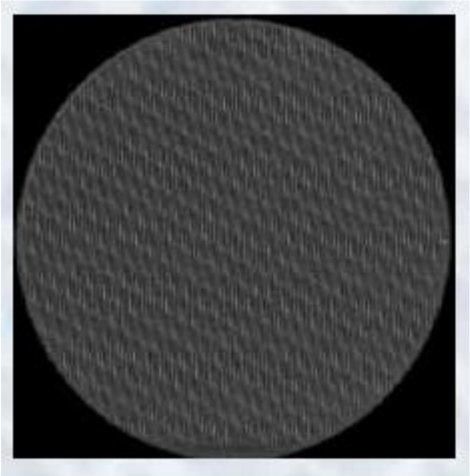
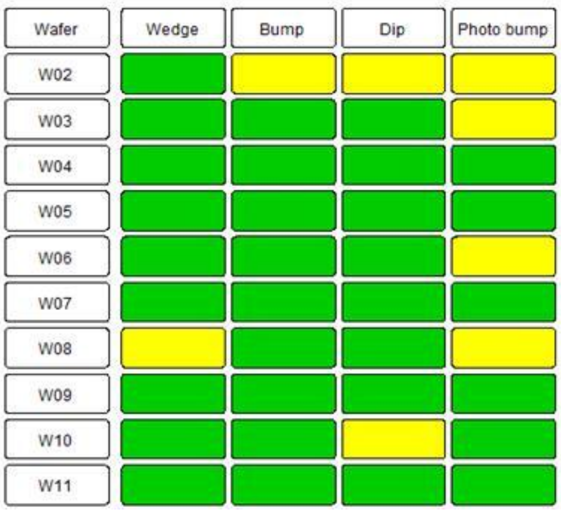


Figure 1: SAM Map

RESULTS

Each of the bonded pairs showed uniform bonding lines regardless of whether they were bonded at TriQuint or Brewer Science. Thickness and variation across the wafer were also measured. TriQuint has created an algorithm to measure thickness uniformity in terms of wedge, bump, dip, and photo bump (bump in the center of the wafer), as shown in Figure 2. Green represents “good” while yellow represents “marginal” and red represents “rework.” The image shows that all wafers measured from the first demonstration passed without requiring rework.



Wafer	Wedge	Bump	Dip	Photo bump
W02	🟩	🟨	🟨	🟨
W03	🟩	🟩	🟩	🟨
W04	🟩	🟩	🟩	🟩
W05	🟩	🟩	🟩	🟩
W06	🟩	🟩	🟩	🟨
W07	🟩	🟩	🟩	🟩
W08	🟨	🟩	🟩	🟨
W09	🟩	🟩	🟩	🟩
W10	🟩	🟩	🟨	🟩
W11	🟩	🟩	🟩	🟩

Figure 2: Post-Mount Thickness Uniformity

In addition to mounting, many challenges associated with demounting and cleaning the wafers had to be overcome. Each step in the mounting process proved to play a significant role in the demounting and clean processes, making it even more critical that the mounting process was properly optimized.

CONCLUSIONS

The Brewer Science® WaferBOND® HT-10.10 temporary bonding material showed excellent results while decreasing the amount of the material used compared to the standard bonding material.

ACKNOWLEDGEMENTS

ACRONYMS

SAM: Scanning Acoustic Microscope
TTV: Total Thickness Variation