

AN IMPROVED EJECTOR NEEDLE

1. Field Of The Invention

This invention relates to an improved ejector needle, a method for its manufacture, and to its use in the fabrication of microelectronic devices such as semiconductor chips.

2. Background Of The Invention

Semiconductor chips are used extensively throughout the microelectronics industry and with the advent of very large-scale integrated circuits ("VLSI") there is an ever-increasing demand for a greater component density per unit of microelectronic real estate. Consequently, to meet a growing demand for smaller and cheaper applications semiconductor chips themselves must be fabricated having smaller dimensions. The demand for thin chips in, for example, 3D stacking memory devices, RF power packages, smart cards and smart labels, requires ultra-thin wafers.

In the past much of the prior art has focused on the semiconductor wafer and its composition. Although wafers are now designed which are considerably smaller and more reliable than their predecessors little energy has been directed towards the process of demounting the wafer from its support medium during processing. The ability to obtain discrete completed dies with no process flaws and with a minimum of damaged dies is much desired in the industry.

Because of the limitations inherent in the prior art methods, new and innovative manufacturing methods are constantly being sought to successfully meet the industry demands to reduce assembly losses resulting from damage to individual die components. A majority of these assembly losses occur as a consequence of incorrect die ejector needle set up or the use of poor or inadequate needle selection. At the production level this results in damage to the back side of the die or cracking or marking of the die. The dies when marked, cracked or damaged in this way are no longer fit for use.

In general, the manufacture of microelectronic components involves placing a number of suitable devices such as semiconductor chips populated with the requisite layout onto an adhesive film or tape. The adhesive film or tape allows the manufacturer to build the chip. However, once built it is necessary to release individual dies without damaging the individual components from their wafer

support and to separate them into discrete units for later packaging. This stage in the manufacture of any microelectronic device is problematic to the industry and is the cause of considerable frustration. Because the devices are small and delicate any unnecessary contact or a misalignment of the contact between the devices and miniature extraction or deflection implements such as ejector needles, Die push-up needles micro-tweezers, die ejector pins, or needle blocks can damage the microelectronic device, rendering it unfit for further processing. Such losses are costly to the industry.

Accordingly, there is a need for improved methods and tools for releasing microelectronic devices and in particular semiconductor dies from an adhesive support film or tape.

3. Objects Of The Invention

It is an object of the invention to provide an ejector needle which will go some way towards obviating or minimizing the aforementioned disadvantages, or one which will at least provide the public with a useful choice.

4. Statement of the Invention.

Accordingly, in its broadest aspect the invention provides for an ejector needle, suitable for use in microelectronic device manufacture, which has a hardness sufficient to release or deflect a die from its adhesive support without damage to the die or to the die backing and wherein the ejector needle is made from a material other than hardened steel, high speed steel or tungsten carbide.

Accordingly, in a second aspect the invention provides for an ejector needle of a hardness sufficient to allow a die to be released or deflected from its adhesive support without damaging the die or die backing and which will itself break or deform before causing damage to the die during the release process.

Preferably, the ejector needle, suitable for use in microelectronic device manufacture, has a hardness of M78-M80.

Preferably, the ejector needle comprises a thermoplastic material.

Preferably, the thermoplastic material is an elastic, anti-static thermoplastic polymer or similar.

Preferably, the ejector needle has a needle tip radius of between 50 and 500 microns, and most preferably the radius is from about 100 to 300microns.

Preferably, the die size has a width of from 0.1mm to about 10mm and a length of from about 0.1mm to about 10mm.

Preferably, a plurality of the ejector needles are combined or arrayed to form a needle block.

According to a third aspect of the invention there is provided a ejector needle suitable for use in microelectronic device manufacture which comprises a thermoplastic polymer having a hardness of M78-M80 and which has the following dimensions:

- (i) a needle tip radius of from about 50 to 500 microns,
- (ii) a needle length of from about 10 to about 30mm,
- (iii) a needle tip angle of from about 5 to about 70 degrees from the longitudinal axis, and
- (iv) a needle diameter of from about 0.1 to about 2mm and

Preferably, the ejector needle is made of a thermoplastic polymer having:

- (i) a needle tip radius of from about 100 to 300 microns,
- (ii) a needle length of from about 15 to about 20mm,
- (iii) a needle tip angle of from about 5 to about 20 degrees from the longitudinal axis, and
- (iv) a needle diameter of from about 0.1 to about 1mm.

A fourth aspect of the invention provides for a method of releasing individual dies from an adhesive backing support, the method comprising the steps of:

- (i) mounting a wafer containing a plurality of discrete chips onto a flexible, adhesive foil
- (ii) sawing the wafer into individual die components, and
- (iii) propelling or otherwise presenting an ejector needle or ejector needle block according to the first, second or third aspect of the invention to the back side of each die with a force sufficient to both break the adhesion forces between the adhesive foil and the die back and to present the die to a vacuum pick up tool to be further processed.

A fifth aspect of the invention relates to the use of an ejector needle or ejector needle block according to the first, second or third aspect of the invention or in a method according to the fourth aspect of the invention in the manufacture of a semiconductor wafer-fabricated chips or dies.

A sixth aspect of the invention relates to a microelectronic device whenever manufactured using a ejector needle or ejector needle block according to according to the first, second or third aspect of the invention or in a method according to the fourth aspect of the invention.

5. Definitions

Die. A single rectangular piece of semiconductor material onto which specific electrical circuits have been fabricated; refers to a semiconductor which has not yet been packaged.

Wafer. A thin disk (or slice) of silicon on which many separate chips can be fabricated and then cut into individual die.

Thermoplastic. A material that will repeatedly soften when heated and harden when cooled. A thermoplastic will soften, flow, distort appreciably, or break (if hard) when subjected to sufficient heat and pressure. Examples of thermoplastics are: acetal, acrylic, cellulosic, chlorinated polyether, fluorocarbons, polyamides (nylons), polycarbonate, polyethylene, polypropylene, polystyrene, some types of polyurethanes, and vinyl resins.

Hardness: Hardness is defined as a material's resistance to indentation when a static load is applied. The most common instrument used for measuring hardness is Shore Durometer. It measures the depth of penetration of an indenter on a scale from zero to a tenth of an inch (0.1 in.). A zero reading indicates that penetration depth was at its maximum; a reading of 100 specifies there was no penetration.

Rockwell hardness testing is a general method for measuring the bulk hardness of metallic and polymer material (plastic). Although hardness testing does not give a direct measurement of any performance properties, hardness correlates with strength, wear resistance. The Rockwell method measures the permanent depth of an indentation produced by a force on an indenter.

Rockwell hardness scales B and C are generally used for metals. The Rockwell E, M , R scales are used for polymers.

Yield. Number of acceptable units (die) produced on each wafer compared to the maximum possible.

Microelectronic device is used as a term to cover Semiconductor wafer-fabricated chips or dies such as circuit chips, laser chips, IC chips, laser bars and the like.

6. Brief Description Of The Drawings

The invention will now be described by way of a non-limiting example only and with reference to the accompanying drawings in which:

FIG. 1 shows an ejector needle having a needle tip angle of 10° , a needle tip radius of 200 microns and a needle length of 18mm.

FIG. 2 shows an ejector needle having a needle tip angle of 15° , a needle tip radius of 250 microns and a needle length of 16.5mm.

FIG. 3 shows an ejector needle having a needle tip angle of 15° , a needle tip radius of 100 microns and a needle length of 18mm.

FIG. 4 shows an ejector needle having a needle tip angle of 15° , a needle tip radius of 200 microns and a needle length of 18mm.

FIG. 5 illustrates a die pick up procedure.

The below Examples and Figures provide product evaluation information of plastic ejector needles and more particularly to needles made from a thermoplastic, having a Rockwell Hardness of M78-M80.

FIG. 6 Needle information.

FIG. 7 Plastic Ejector Needle On ESEC 2007 Machine.

FIG. 8 Plastic Ejector Needle On ASM AD889 Machine.

FIG. 9 Needle Information.

FIG. 10 Actual vs Quality Results.

FIG. 11 Needle Information.

FIG. 12 Ejector Needle Condition. Ejector Up Level Setting 310 motor step. Inspection under High Power Scope.

FIG. 13 Ejector Needle Condition. Ejector Up Level Setting 310 motor step. Inspection under High Power Scope.

FIG. 14 Ejector Up Level 310 and 330.

FIG. 15 Ejector Up Level 305 and 340.

FIG. 16 Ejector Needle Condition. Ejector Up Level Setting 300. Inspection under High Power Scope (5x).

FIG. 17 Ejector Up Level 300 and 340.

7. Description Of The Invention

One of the key process steps in the manufacture of semiconductor memory chips is the separation of discrete, individual die components from a wafer mount. The present invention is directed to the assembly stage of a semiconductor chip manufacture and more particularly relates to the release of individual dies from an adhesive tape on which they have been held while the chip was being built. The final assembly steps of a fabricated and tested semiconductor chip involve the following generic stages, although manufacturing variations will occur depending on the manufacturer involved, the tools employed and type of component being made. It is one example of which there are many.

In general the stages are:

7.1 Wafer Mounting and Sawing . This step attaches a wafer and a film frame to adhesive tape (mylar) or to ultra-violet sensitive (UV) tape. The tape holds the wafer and die in place during subsequent processing. A diamond-edged saw blade, approximately the thickness of a human hair,

cuts the wafer into individual die. As an example a blade can spin at 45,000 revolutions per minute and cut at speeds of 8.9 centimeters (3.5 inches) per second. During the cutting process, water is sprayed on both the blade and the wafer to keep the temperature low and to remove damaging debris. After cutting the wafer receives a final high-pressure rinse wash.

7.2 Die Pick-up and Place (Die Release/Attachment). In this stage a wafer map is created by a test Probe. The map identifies die suitable for further processing. The die selected are removed from the wafer, and placed with adhesive on a leadframe or an "interposer" generally at speeds of up to 4,000 die per hour. To remove the die from the foil or tape, ejector needles push up from beneath the tape as a vacuum tip lifts the die from the top. Unsuitable or damaged die are left on the adhesive and discarded. Selected complete functional die are then adhered to an interposer--or lead frame--and batches of interposers are cured in an oven to set the adhesive/epoxy.

7.3 Wire Bonding. Thin Gold wire—99.9999% pure and thinner than a human hair—is attached to the die and the interposer. The gold wire provides the communication path (circuitry connection) between the die and the computer. Ultrasonic gold-ball bonding, a technique that combines ultrasonic energy, heat, and force, is capable of interconnecting the die bond pads to the interposer/leadframe bond pads.

7.4 Encapsulation. During Encapsulation, the die and a small portion of the interposer/leadframe are covered with a hard plastic compound to protect the die. The equipment encapsulates the die by moving the interposers into a mold area, using force to inject heated compound into the mold cavities, and curing the compound. The mold is opened, and the interposers are pressed out and cleaned.

7.5 Lead Finishing. Product must now go through either an Electroplating or Solder-ball Attach process. In electroplating, the exposed metal on a leadframe is covered with a conductive metal coating. While submerged in a tin and lead solution, leadframes are charged to attract the tin and lead ions. This results in a uniform plated coating that increases conductivity, keeps the leads from rusting, and provides a clean, even surface. In solder-ball attach, solder balls and flux are placed on gold-plated pads located on the substrate. When heat is applied to the part, the solder balls adhere to the pads. Leads or solder balls provide the final interconnect between the component and the board application in the end-use product.

7.6 Trimming and Forming. In Trim & Form, leadframes are loaded into trim-and-form machines where the leadfingers are formed step by step until finally the chips are severed from the frames. An opens-and-shorts test is performed on each device, and the devices are sorted into good or reject trays or tubes. The various positions and shapes of the leads and the package size and shape depend on the final application and the customer's packaging requirements.

The present invention is concerned with that a part of the assembly process referred to as the die pick-up and place process. It is at this stage that individual die are removed from the plastic foil on which they are seated and placed either in an intermediate carrier or lifted and placed directly onto a substrate such as a die attachment material. In most instances a pick & place machine is used together with a die bonder. The machine will contain an ejector needle or ejector block containing a number of similarly proportioned needles. The needle or needle block will be forced up against the back side of the die wherein adhesion forces holding the die to the foil are broken. The die will be released from the foil and presented to a collet and lifted and grabbed (picked) for transfer to be further processed via above steps 7.3 and onwards.

Surprisingly, the present inventors have found that many of the production faults occurring at the pick and place processing stage can be eliminated or at least substantially reduced by selecting ejector needles made from materials which are more forgiving on contact with the back side of dies. At present ejector needles or pins made from high speed steel (HSS) or tungsten carbide (WC) are used. The needles that are presently available have a hardness which is unsympathetic to the processes for which they are used. The inherent hardness of the high speed steel or carbide ejector needles damages either the sticky adhesive layer on which the dies are seated or chips, cracks or fractures the dies themselves. Further, the process of lifting individual dies from their adhesive foil requires constant operator vigilance and expertise. It is essential for an operator to select not only the correct needle type for the die to be displaced but also the precise needle height and speed for the operation. There is little or no room for error. Damage caused when an incorrect ejector needle type, an incorrect ejector needle height or ejector needle speed is selected is a constant source of operator frustration and results in undesirable production losses. Machine downtime to reset operating parameters is also a cause of considerable annoyance.

The present invention therefore provides an innovative solution to the above problems. By using an ejector needle made from a thermoplastic material it has been found that not only is damage to dies, evident at the pick and place stage of semiconductor assembly, eliminated or at least substantially reduced but also that faults resulting from operator error are also significantly reduced. The use of a thermoplastic ejector needle has gone some way to providing relative operational latitude to what is for all intents and purpose a meticulous and precise process.

8. Detailed description of a Preferred Embodiment of The Invention

In one embodiment, the present invention provides for an improved ejector needle wherein conventional ejector needle materials used in the Die-attach (DA) assembly stages of microelectronic component fabrication are replaced with a thermoplastic material or composite thermoplastic materials.

In a most preferred embodiment the present invention relates to an ejector needle made from one or more thermoplastic polymers. The ejector needles of the present invention also obviate many of the defects commonly related to drilling when the incorrect or inappropriate ejector needle is used.

These defects may be categorised as:

Die Cracking

Die Chipping,

Die Fracture and

Die Back Marking,

(See the Appendix for more detail).

Surprisingly the invention uses an engineerable thermoplastic with anti-static properties to prepare an ejector needle. The thermoplastic retains its high tensile and impact strength at temperatures of 120 degrees C.

Typically, the ejector needle is machined from a thermoplastic polymer having a hardness of M78-M80 and which has the following dimensions:

- (i) a needle tip radius of from about 100 to 300 microns,
- (ii) a needle length of from about 15 to about 20mm,
- (iii) a needle tip angle of from about 5 to about 20 degrees from the longitudinal axis, and
- (iv) a needle diameter of from about 0.1 to about 1mm.

Where in the foregoing description reference has been made to integers or components having known equivalents then such equivalents are herein incorporated as if individually set forth.

9. Examples

Turning now to Figures 1, 2, 3 and 4 ejector needles are shown having the following dimensions.

	Example 1	Example 2	Example 3	Example 4	Conventional Needle
Tip Radius mμ	100	250	100	200	<100
Tip Angle	15	10	15	15	10 - 15
Needle Length mm	11.5	16.5	18.0	18.0	14 - 18
Needle diameter mμ	70	70	70	70	60 - 70

The ejector needle is machined from an engineering thermoplastic, designated in-house as Zirneon TL-216.

Important features of the needle relate to the radius of the needle tips which are shown as having radii of 100mm, 250mm, 100mm and 200mm respectively. Conventional ejector needles made from HSS and TC generally have needle tips with a radius of 100mm or less. The reader will also note that the angle of tip of needles of the present invention is also substantially less than comparable conventional needles.

An equally important feature of the thermoplastic materials of the ejector needle of the invention is that it has a hardness of M78-M80 (measured in the Rockwell Scale). This hardness characteristic allows the needle to be machined to exact dimensional specification and provides good dimensional stability in use, yet also allows the ejector needle to break when under stress rather than causing damage to the die.

Figure 5 is a diagrammatic representation of a pick and place apparatus suitable for use in the present invention. The release of a semiconductor chip from a foil involves a pick head having a chip gripper (1). The chip gripper is placed under vacuum and provided with a pick force, which allows a die (2) to be drawn upwards and/or sideways away from the adhesive foil. Simultaneously to the lowering of the pick head the ejector needle (3) is ejected out from its pepper pot housing (4)

with a sufficient force to release the die from the adhesive foil whereupon the die is met and secured by the pick head and transported to the next process stage. A chip ejector not shown holds the underneath of the adhesive foil by means of vacuum

10. Modifications/Variations of The Preferred Embodiments

While the invention has been described with particular reference to certain embodiments thereof, it will be understood that various modifications can be made to the above-mentioned embodiment without departing from the spirit and scope of the present invention. The examples and the particular proportions set forth are intended to be illustrative only. For example, the precise nature of the thermoplastic material from which the ejector needle is made may be varied providing that requisite characteristics of hardness (Rockwell Scale M78-M80), good machinability and dimensional stability are maintained. It will also be understood that the precise dimensions of the ejector needles will also vary depending on the size and type of the die being made and the speed of operation.

A Hardness of M78-M80 measured using the Rockwell Scale has an approximate Shore Hardness of D785. Those of ordinary skill in the art will readily understand the comparisons between the different hardness scales.

Throughout the description and claims of this specification the word “comprise” and variations of the word, such as “comprises” and “comprising”, are not intended to exclude other additives, components, integers or steps.

EXAMPLES

Plastic Ejector Needle as an Alternative to HSS or TC needles

- 1) eliminates or substantially reduces die back marking and die cracking caused by :
- i) Wrong setup of ejector needle.
 - ii) Wrong ejector needle material used due to identification mistake.

Needle Information

Needle Radius	: 100 micron
Material	: Plastic (Rockwell Hardness M78-M80)
Needle Length	: 18.0mm
Needle Angle	: 10.0 degree
Needle diameter	: 0.7 mm

ESEC 2007 Parameter Setting

Machine DA L5/Mc. 1

Pickup Time : 300 ms
Foil Touch Time : -200 ms
Needle Top Height : 1.2 mm
Ejector Height Offset : 0.6 mm
Needle Velocity : 40 mm/s

Bond Head Vacuum : 430 mmhg
Ejector Vacuum : 550 mmhg

ASM AD889 Parameter Setting

Machine DA L15/Mc. 2

Ejector Home Level : 0
Mylar Level : 0
Pre Eject Level : 50
Ejector Up : 190
Ejector Drive In : 0
Home = Mylar-RSM : NO

Bond Head Vacuum : 530 mmhg
Ejector Vacuum : 530 mmhg

Plastic Ejector Needle On ASM AD889 Machine

- 1 No die back mark encountered after 10 days running on ESEC 2007.
- 2 No die back mark encountered after 8 days running on ASM AD889.
- 3 Non pierce through of mylar on ESEC 2007 & ASM AD889 machines.
- 4 Total units produced was 226.9K on ESEC and 337.6K on ASM AD 889.
Total die pick up fail – 113 / 226.9K (ESEC)
Total die pick up fail – 219 / 337.6K (ASM)
5. No mistake in wrong needle material used due to Plastic needle is easily differentiate as compared to HSS needle Vs Tungsten Carbide needle.
6. Zero dice placement error encountered throughout this evaluation.
7. Needle wear out : $18.0 \text{ mm} - 17.93 \text{ mm} = 0.07 \text{ mm}$

Plastic Ejector Needle Evaluation

Needle Information

Needle Radius : 100 micron
Material : Plastic (Rockwell Hardness M78-M80)
Needle Length : 18.0mm
Needle Angle : 10.0 degree
Needle diameter : 0.7 mm

LIFE SPAN VS QUALITY RESULTS

DAY USED	PICKUP ERROR	MYLAR PIERCE THRU	DIE BACK MARK	NEEDLE WEAR & TEAR	USED / K
NEW	0 / 50 units	0 / 50 units	0 / 50 units	18.002 MM	0
3 DAYS	0 / 50 units	0 / 50 units	0 / 50 units	17.953 MM	180K
5 DAYS	0 / 50 units	0 / 50 units	0 / 50 units	17.895 MM	300K
7 DAYS	0 / 50 units	0 / 50 units	0 / 50 units	17.883 MM	420K
9 DAYS	5 / 50 units	0 / 50 units	0 / 50 units	17.815 MM	540K

Plastic Needle Results
(200 μ m radius-with sleeve, big die)

NEEDLE INFORMATION

Details:

Needle Radius = Near to 200 μ m flat tip
Material = Plastic (Rockwell Hardness M78-M80)
Needle Length = 17.989 mm
Needle Angle = 34.30°
Needle Diameter = 0.7 mm

DIE INFORMATION

Device = ABLR*A061CAQ
Die Thickness = 375 $\pm$ 25 μ m
Die Size = 2890 μ m x 2560 μ m
Die Finish Back = Raw Silicon
Machine Type = ASM AD 889
Machine # / Line = NRS 20, DA#2

PARAMETER SETTING

PARAMETER	SETTING	PARAMETER	SETTING
BHTable Pick Delay	: 50	Arm Bond Delay	: 60
Head Pick Delay	: 30	Head Bond Delay	: 60
Pre-eject Delay	: 0	Suck Bond Delay	: 20
Eject Up Delay	: 30	Wafer expansion	: 30
Pick Delay	: 60	Bond Delay	: 60

Ejector height max (with sleeve):
1.2mm = 330 motor step

QUALITY

Ejector Up Level Setting = 305 motor step (pickup level)

	<u>Sample size</u>
1. Needle Pierce Through Sticky Foil	0/350
2. Mark On The Die Back	0/25
3. Die Placement Defect	0/1200
4. Unpick Die/missing die (height increase to 310)	8/1200

Ejector Up Level Setting = 330 motor step (max height)

	<u>Sample size</u>
1. Needle Pierce Through Sticky Foil	0/350
2. Mark On The Die Back	0/25
3. Die Placement Defect	0/1200
4. Unpick Die/missing die	0/1200

After 8 days running with 260,341 unit:

No pierce through faced and we only can see the sleeve mark after 4 days running. Also no dice back mark for each level monitoring.

DIE BACK MARK AND TAPE PIERCE THRU MONITORING

Ejector Up Level Setting 310 motor step

Inspection Under High Power Scope (20 x)

No. of day (s)	Day 1 (7/11)	Day 2 (8/11)	Day 4 (10/11)	Day 5 (11/11)	Day 6 (12/11)	Day 7 (13/11)	Day 8 (15/11)
Die back mark	No mark	No mark	No mark	No mark	No mark	No mark	No mark
Tape pierce thru	No	No	No	No	No	No	No

COMMENTS

- 1.No die back mark encountered after monitoring.
- 2.No die back mark encountered on ejector up level 330 (maximum setting).
- 3.No die back mark encountered on ejector up level 305 (pickup level).
- 4.No sticky foil pierce through encountered on ejector up level 330 (maximum setting).
- 5.No sticky foil pierce through encountered on ejector up level 305.
- 6.At ejector up level 305 , failed to pick dice 8 times out of 1200 sample units. Needle height changed to 310.
- 7.Needle wear rate is 0.28% after evaluation with total output 260.3K.
- 8.After 4 days running, we can see the ejector sleeve mark at the mylar surface. No pierce through after 8 days running production.

Plastic Needle Evaluation Report On Blue Tape

BGA23x23/NRS

OBJECTIVE

To eliminate die back mark initiated by Tungsten Carbide ejector needle which could lead to crack die problem.

NEEDLE INFORMATION

Needle Radius = 100 μ m
Material = Plastic
Needle Length = 18.000 mm
Needle Angle = 10.0 °
Needle Diameter = 0.7 mm

DIE INFORMATION

Device = UFAH*TX21CAP
Die Thickness = 375 $\pm$ 25 μ m
Dice Size = 2940 μ m (x) , 2940 μ m (y)
Die Finish Back = Raw silicon
Machine Type = ASM AD 889

Machine # / Line = NRS L3/DA2

PARAMETER SETTING

PARAMETER	SETTING	PARAMETER	SETTING
BHTable Pick Delay	: 50	Arm Bond Delay	: 50
Head Pick Delay	: 50	Head Bond Delay	: 50
Pre-eject Delay	: 0	Suck Bond Delay	: 30
Eject Up Delay	: 0	Wafer expansion	: 30
Pick Delay	: 50	Bond Delay	: 70

QUALITY

Ejector Up Level Setting = 305	<u>Sample size</u>
Needle Poke Through Sticky Foil	0/30
Mark On The Die Back	0/20
Die Placement Defect	0/1200
Unpick Die	13/1200
Ejector Up Level Setting = 340	<u>Sample size</u>
Needle Poke Through Sticky Foil	0/30
Mark On The Die Back	0/20
Die Placement Defect	0/1200
Unpick Die	0/1200

DIE BACK MARK AND TAPE PIERCE THRU MONITORING

Ejector Up Level Setting 330

Inspection Under High Power Scope (20 x)

No. of day(s)	1	2	3	4	5	6	7	8	9	10	11
Die back mark	No mark	No mark	No mark	No mark	No mark	No mark	No mark	No mark	No mark	No mark	No mark
Tape pierce thru	No	No	No	No	No	No	No	No	No	No	No

EJECTOR NEEDLE CONDITION

Ejector Up Level Setting 330.

Inspection Under High Power Scope (5 x)

OBSERVATION / COMMENTS

- 1.No die back mark encountered during this 11 days monitoring.
- 2.No die back mark encountered on ejector up level 340 (maximum setting).
- 3.No die back mark encountered on ejector up level 305.
- 4.No sticky foil poke through encountered during this 11 days monitoring.
- 5.No sticky foil poke through encountered on ejector up level 340 (maximum setting).
- 6.No sticky foil poke through encountered on ejector up level 305.
- 7.At ejector up level 305 , failed to pick dice 13 x.
- 8.Needle wear rate is 0.633 % after 11 days evaluation with total output 454 K.

Plastic Needle Evaluation Report On UV Tape

BGA23x23/NRS

OBJECTIVE

To eliminate die back mark initiated by Tungsten Carbide ejector needle which could lead to die crack problem.

NEEDLE INFORMATION

Needle Radius = 100 μ m
Material = Plastic
Needle Length = 18.000 mm
Needle Angle = 10.0 °
Needle Diameter = 0.7 mm

DIE INFORMATION

Device = MFHX*TO21AGP
Die Thickness = 235 $\pm$ 20 μ m
Dice Size = 5300 μ m (x) , 5390 μ m (y)
Die Finish Back = Raw silicon
Machine Type = ASM AD 889
Machine # / Line = NRS L1/DA2

PARAMETER SETTING

PARAMETER	SETTING	PARAMETER	SETTING
Ejector Up Level	: 300	Pick Delay	: 50
Pick Level	: 610	Arm Bond Delay	: 30
Buttle Pick Delay	: 30	Head Bond Delay	: 30
Head Pick Delay	: 30	Suck Bond Delay	: 30
Pre-eject Delay	: 0	Wafer expansion	: 7
Eject Up Delay	: 0		
Pick Delay	: 50		

QUALITY

Ejector Up Level Setting = 300	<u>Sample size</u>
Needle Poke Through Sticky Foil	0/20
Mark On The Die Back	0/20
Die Placement Defect	0/1000
Unpick Die	0/1000

Ejector Up Level Setting = 340	<u>Sample size</u>
Needle Poke Through Sticky Foil	0/20
Mark On The Die Back	0/20
Die Placement Defect	0/1000
Unpick Die	0/1000

DIE BACK MARK AND TAPE PIERCE THRU MONITORING

Ejector Up Level Setting 300

Inspection Under High Power Scope (20 x)

No. of day(s)	1	2	3	4	5	6	7	8	9	10	11	12
Die back mark	No mark	No mark	No mark	No mark	No mark	No mark	No mark	No mark	No mark	No mark	No mark	No mark
Tape pierce thru	No	No	No	No	No	No	No	No	No	No	No	No

OBSERVATION / COMMENTS

- 1.No die back mark encountered during this 12 days monitoring.
- 2.No die back mark encountered on ejector up level 340 (maximum setting).
- 3.No die back mark encountered on ejector up level 300.
- 4.No sticky foil poke through encountered during this 12 days monitoring.
- 5.No sticky foil poke through encountered on ejector up level 340 (maximum setting).
- 6.No sticky foil poke through encountered on ejector up level 300.
- 7.Needle wear rate is 0.56 % after 12 days evaluation with total output 377 K

Claims

1. An ejector needle for use in microelectronic device manufacture, the ejector needle comprising a thermoplastic and wherein the ejector needle has a hardness sufficient to release or deflect a die from an adhesive support without damage to the die or to a die backing.
2. An ejector needle for use in microelectronic device manufacture which is of hardness sufficient to allow a die to be released or deflected from an adhesive support without damaging the die or die backing and which will itself break or deform before causing damage to the die or die backing during the release process.
3. An ejector needle for use in microelectronic device manufacture which has a hardness of M78-M80 measured by the Rockwell Scale.
4. An ejector needle for use in microelectronic device manufacture comprising a thermoplastic and wherein the ejector needle has a hardness sufficient to release or deflect a die from an adhesive support without damage to the die or to the die backing and has the following dimensions:
 - (i) a needle tip radius of from about 50 to 500 microns,
 - (ii) a needle length of from about 10 to about 30mm,
 - (iii) a needle tip angle of from about 5 to about 70 degrees from the longitudinal axis, and
 - (iv) a needle diameter of from about 0.1 to about 2mm.
5. A thermoplastic ejector needle for use in microelectronic device manufacture which has a hardness sufficient to release or deflect a die from an adhesive support without damage to the die or to the die backing and has the following dimensions:
 - (i) a needle tip radius of from about 50 to 500 microns,
 - (ii) a needle length of from about 10 to about 30mm,
 - (iii) a needle tip angle of from about 5 to about 70 degrees from the longitudinal axis, and
 - (iv) a needle diameter of from about 0.1 to about 2mm.

6. An ejector needle for use in microelectronic device manufacture which is of hardness sufficient to allow a die to be released or deflected from an adhesive support without damaging the die or die backing and which will itself break or deform before causing damage to the die or die backing during the release process and which has the following dimensions:
- (i) a needle tip radius of from about 50 to 500 microns,
 - (ii) a needle length of from about 10 to about 30mm,
 - (iii) a needle tip angle of from about 5 to about 70 degrees from the longitudinal axis, and
 - (iv) a needle diameter of from about 0.1 to about 2mm.
7. An ejector needle according to Claim 4 or Claim 6 or a thermoplastic ejector needle according to Claim 5 wherein the ejector needle or thermoplastic ejector needle has:
- (i) a needle tip radius of from about 100 to 300 microns,
 - (ii) a needle length of from about 15 to about 25mm,
 - (iii) a needle tip angle of from about 5 to about 20 degrees from the longitudinal axis, and
 - (iv) a needle diameter of from about 0.1 to about 1mm.
8. An ejector needle according to Claim 4 or Claim 6 or a thermoplastic ejector needle according to Claim 5 having a hardness of M78-M80 measured by the Rockwell Scale.
9. The ejector needle according to Claim 2, Claim 3 or Claim 6 wherein the ejector needle comprises a thermoplastic.
10. The ejector needle or thermoplastic ejector needle according to any one of Claim 1, Claim 4, Claim 5 or Claim 9 wherein the thermoplastic is an elastic, anti-static thermoplastic polymer, or similar.
11. The ejector needle or thermoplastic ejector needle according to any one of Claim 1, Claim 4, Claim 5 or Claim 9 wherein the thermoplastic is a thermoplastic polymer designated Zirneon TL-216.
12. The ejector needle or thermoplastic ejector needle according to any one of the preceding Claims wherein the needle has a needle tip radius of between 50 and 500 microns, and most preferably a radius of from about 100 to 300 microns.

13. Use of the ejector needle or thermoplastic ejector needle according to any one of the preceding Claims wherein the ejector needle or the thermoplastic ejector needle releases or deflects a die having a width of from 0.1mm to about 10mm and a length of from about 0.1mm to about 10mm.
14. The ejector needle or thermoplastic ejector needle according to any one of the preceding Claims wherein the needle tip angle is less than 30° when measured from the longitudinal axis.
15. An ejector needle block comprising a plurality of the ejector needles and/or a plurality of the thermoplastic ejector needles according to any one of the preceding Claims combined or arrayed to form said ejector needle block.
16. A method of releasing an individual die from an adhesive backing support, the method including the steps of:
- (i) mounting a wafer containing a plurality of discrete chips onto a flexible, adhesive foil,
 - (ii) sawing the wafer into individual die components, and
 - (iii) propelling or otherwise presenting an ejector needle or ejector needle block according to any one of the preceding Claims to the back side of one or more of the die components with a force sufficient to both break the adhesion forces between the adhesive foil and the die back and to thereby present the die to a pick up tool to be further processed.
17. A use of an ejector needle or ejector needle block according to any one of Claims 1-15 or in a method according to Claim 16 in the manufacture of a microelectronic device.
18. A microelectronic device manufactured using an ejector needle, thermoplastic ejector needle or ejector needle block according to any one of Claims 1-15 or in a method according to Claim 16.
19. An ejector needle according to claim 8 which has:
- (i) a needle tip radius of from about 100 to 300 microns,
 - (ii) a needle length of from about 15 to 25 mm,
 - (iii) a needle tip angle of from about 5 to about 20 degrees from the longitudinal axis, and
 - (iv) a needle diameter of from about 1.0 to about 1mm.