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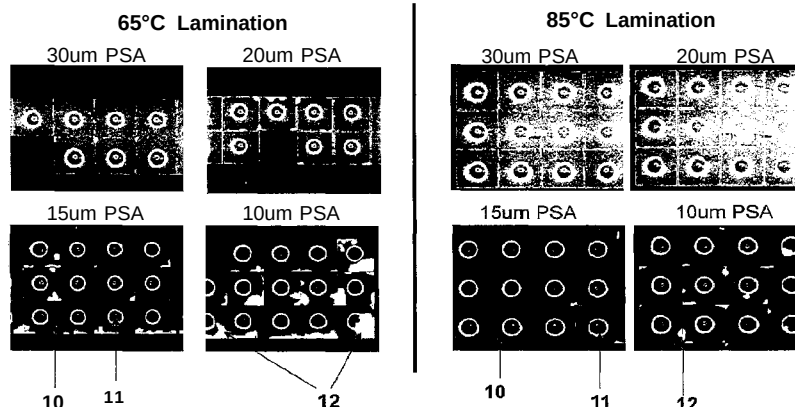
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(54) **Title:** DICING TAPE FOR ROUGH SURFACE DIE ATTACH FILM

FIGURE 1



(57) **Abstract:** A dicing tape comprises a carrier and a pressure sensitive adhesive in which the thickness of the pressure sensitive adhesive is 15µm to 50µm. With this thickness, conductive die attach adhesive film bundled with the dicing tape removes cleanly from the dicing tape.

DICING TAPE FOR ROUGH SURFACE DIE ATTACH FILM

BACKGROUND OF THE INVENTION

[0001] This invention relates to a dicing tape for semiconductor wafers and conductive die attach adhesive films.

[0002] Integrated circuits are fabricated on the surfaces of semiconductor wafers, composed of materials such as silicon and gallium-arsenide. The wafer is then separated into individual integrated circuits by dicing the wafer with a saw or laser.

[0003] After dicing and separation from the wafer, the individual integrated circuits are bonded to a substrate that is used in the manufacture of the circuits for the ultimate electronic device. Bonding of an individual integrated circuit to its substrate is accomplished with an adhesive, known as a die attach adhesive, which comprises an adhesive resin and up to about 90% by weight of conductive filler. Current fabrication operations favor applying the conductive die attach adhesive directly to the back side of the wafer before dicing, as it is more efficient than applying the die attach adhesive to each individual integrated circuit or to a bond site for the integrated circuit on the substrate.

[0004] Typically, the conductive die attach adhesive is provided as a film on a carrier support tape or sheet (hereinafter "carrier support"). To prepare the film, a die attach adhesive composition is coated onto the carrier support and heated to remove any solvent that is present, or to partially cure the adhesive. This is referred to as B-staging, and brings the adhesive into a film format (herein "adhesive film") and to a less-tacky state than before the heating. This conductive die attach adhesive film subsequently is applied to the side of the wafer opposite the side containing the integrated circuitry (the "back side") before the dicing operation.

[0005] The wafer dicing operation stresses the wafer. To counteract the stress, the wafer is supported on a sheet or tape called a dicing tape during the dicing operation. Many commercially available dicing tapes comprise a carrier tape or sheet and a pressure sensitive adhesive on the carrier, in which the pressure sensitive adhesive layer thickness is in the range of 5 μm to 100 μm .

[0006] In one delivery format, the conductive die attach adhesive film and dicing tape are bundled together and provided as a single unit. The conductive adhesive film is mounted onto

the pressure sensitive adhesive layer of the dicing tape. In this configuration, the pressure sensitive adhesive layer of the dicing tape and the conductive die attach adhesive film are in contact. The conductive die attach adhesive film is adhered to the back side of the semiconductor wafer with the dicing tape attached. Dicing is performed from the top side of the wafer containing the circuitry and the individual semiconductor dies and conductive die attach adhesive film are picked off the dicing tape and placed on the desired substrate.

[0007] A problem arises because the conductive die attach adhesive film is loaded at 80 to 90% by weight with conductive particles that make the surface of the adhesive film rough and uneven. When the rough and uneven surface of the conductive die attach adhesive film contacts the pressure sensitive adhesive on the dicing tape, gaps are formed in those places where contact is missed due to the unevenness. When the semiconductor die and conductive die attach adhesive film are removed from dicing tape after dicing, some of the adhesive film is left on the dicing tape. Since not all of the conductive die attach adhesive film is transferred with the semiconductor die, bonding of the semiconductor die to its desired substrate is not uniform, leading to potential adhesive failure.

SUMMARY OF THE INVENTION

[0008] This invention is a dicing tape comprising a carrier layer and a pressure sensitive adhesive (PSA) layer, in which the thickness of the pressure sensitive adhesive layer is greater than $15\mu\text{m}$. In one embodiment, the thickness ranges from $15\mu\text{m}$ to $30\mu\text{m}$. In another embodiment, the thickness can be in any range, for example up to $50\mu\text{m}$, needed to compensate for any surface unevenness of the conductive die attach adhesive film that will be contacted to the dicing tape adhesive. At this level of thickness, the dicing tape fills in any gaps caused by the rough and uneven surface of the conductive die attach adhesive film when the adhesive film and dicing tape are contacted, and allows a more uniform layer of adhesive film to be removed from the dicing tape for later use in attaching semiconductor dies to substrates.

BRIEF DESCRIPTION OF THE FIGURE

[0009] FIGURE 1 contains optical microscope pictures of dicing tapes, taken from the direction of the PSA on the dicing tape carrier, after the removal of die attach adhesive film from the PSA. The elements are the same for each picture, in which 10 is a square of the dicing tape, the perimeter of the square being visible dicing incisions; 11 is a circular indentation caused by a

mechanical pin that pushed the adhesive film (and individual integrated circuit die) off the dicing tape from the side of the dicing tape opposite to that on which the adhesive film was disposed; 12, the light-colored and irregular shape, is die attach adhesive film left on the dicing tape.

DETAILED DESCRIPTION OF THE INVENTION

[0010] The carrier layer of the dicing tape can be prepared from polymers, metals, fibers, paper, or other suitable materials. In one embodiment, the carrier layer is a polymeric film or sheet, prepared from one or more of polyolefin resin (e.g. polyethylene, propylene copolymers, polybutene, polymethylpentene), ethylene/vinyl acetate copolymer, ethylene/(meth)acrylic acid copolymers, ethylene/(meth)acrylic ester copolymers, ethylene/butene copolymer, ethylene/hexene copolymer, polyurethane, polyester (e.g., poly(ethylene terephthalate), poly(ethylene naphthalate), poly(butylene terephthalate), and poly(butylene naphthalate)), polyimide, polyamide, polyetherketone, polyether, polyethersulfone, polystyrene, polyvinyl chloride), poly(vinylidene chloride), poly(vinyl alcohol), poly(vinyl acetate), vinyl chloride/vinyl acetate copolymer, and polycarbonate. In one embodiment, the carrier layer is a polyolefin.

[0011] The carrier layer may be one that transmits radiation (e.g., X-ray, ultraviolet, or electron beam) so that the pressure sensitive adhesive layer formed on the carrier layer can be cured by irradiating the pressure sensitive adhesive layer from the carrier side if it is radiation curable.

[0012] The carrier layer can be a single layer or a multilayer construction, and in some embodiments may contain fillers, age resisting agents, antistatic agents, ultraviolet absorbers, antioxidants, plasticizers, flame retardants, or surfactants.

[0013] The pressure sensitive adhesive layer on the carrier layer is usually prepared from acrylate and methacrylate monomers. The term (meth)acrylate refers to either or both acrylate or methacrylate. No one particular pressure sensitive adhesive chemistry is preferred and any pressure sensitive adhesive known to those of skill in the art that has good adhesion to the conductive die attach adhesive during dicing and that can be easily and cleanly released afterwards is acceptable.

[0014] Suitable (meth)acrylate monomers include butyl(meth)acrylate, 2-ethyl-hexyl(meth)acrylate, ethyl(meth)acrylate, methyl(meth)acrylate, n-propyl(meth)acrylate,

isopropyl-(meth)acrylate, t-butyl(meth)acrylate, pentyl(meth)acrylate, n-octyl(meth)acrylate, isooctyl-(meth)acrylate, isononyl(meth)acrylate and 2-ethyl-butyl(meth)acrylate.

[0015] (Meth)acrylate functional monomers bearing an additional functional group include the monomers above in which the (meth)acrylate ester also bears one or more substituents selected from a carboxylic acid group, a hydroxyl group, a glycidyl group, an amide group, and an anhydride group. In some embodiments the monomers are (meth)acrylic acid, hydroxyethyl (meth)acrylate, hydroxypropyl (meth)acrylate, hydroxybutyl (meth)acrylate, glycidyl (meth)acrylate, and N-methylol acrylamide.

[0016] For current dicing operations, the thickness of the PSA layer on the dicing tape will be from about $15\mu\text{m}$ to $30\mu\text{m}$. For some operations, a thicker layer, for example up to $50\mu\text{m}$ may be needed to counteract the unevenness in the conductive die attach adhesive film.

[0017] The conductive die attach adhesive film, which comes into contact with the pressure sensitive adhesive layer of the dicing tape, can be prepared from any suitable adhesive resins used in the art for adhering semiconductor dies to substrates. Examples of such adhesive resins include acrylates, epoxies, oxetanes, and maleimides. The exact composition of the adhesive film is not critical to the invention and can be determined by the practitioner for the particular desired end use. The conductive die attach adhesive film conventionally is prepared by coating the conductive die attach adhesive composition onto a carrier support and heating it to B-stage it to a film. Usually a release liner is mounted over the film to protect it.

[0018] The support carrier and the release liner for the conductive die attach adhesive film can be composed of the same or different materials. One suitable material is product number 8322 from St. Gobain Performance Plastics, which can be used for both the support carrier and the release liner. In general, the B-staging operation causes the adhesive film to adhere more strongly to the carrier support than to the release liner. This differential in release may also be accomplished by choosing a release liner and a carrier support that have a difference in release properties, such that the release liner removes more easily from the adhesive film than the adhesive film removes from the support carrier.

EXAMPLE

[0019] A polyolefin carrier (base tape) 80 μm was coated with an acrylate pressure sensitive adhesive at four levels of thickness, namely, 10 μm , 15 μm , 20 μm , and 30 μm to make four dicing tapes.

[0020] Each of these samples was laminated to a 15 μm thick conductive die attach adhesive film containing epoxy and bismaleimide resins and 92% by weight silver particles. Lamination was performed at temperatures of 65°C and 85°C to make a total of eight laminated composites of dicing tape (PSA and carrier) and conductive die attach adhesive film (on polyolefin carrier).

[0021] Each of the laminated composites was diced (not mounted onto a semiconductor wafer) under the following conditions: spindle speed: 40mm/sec; feed speed: 40K rpm; blade: 27HCBB; cut depth: Z2=65 μm . (The cut depth was adjusted from the commercial depth to account for the absence of the semiconductor wafer.)

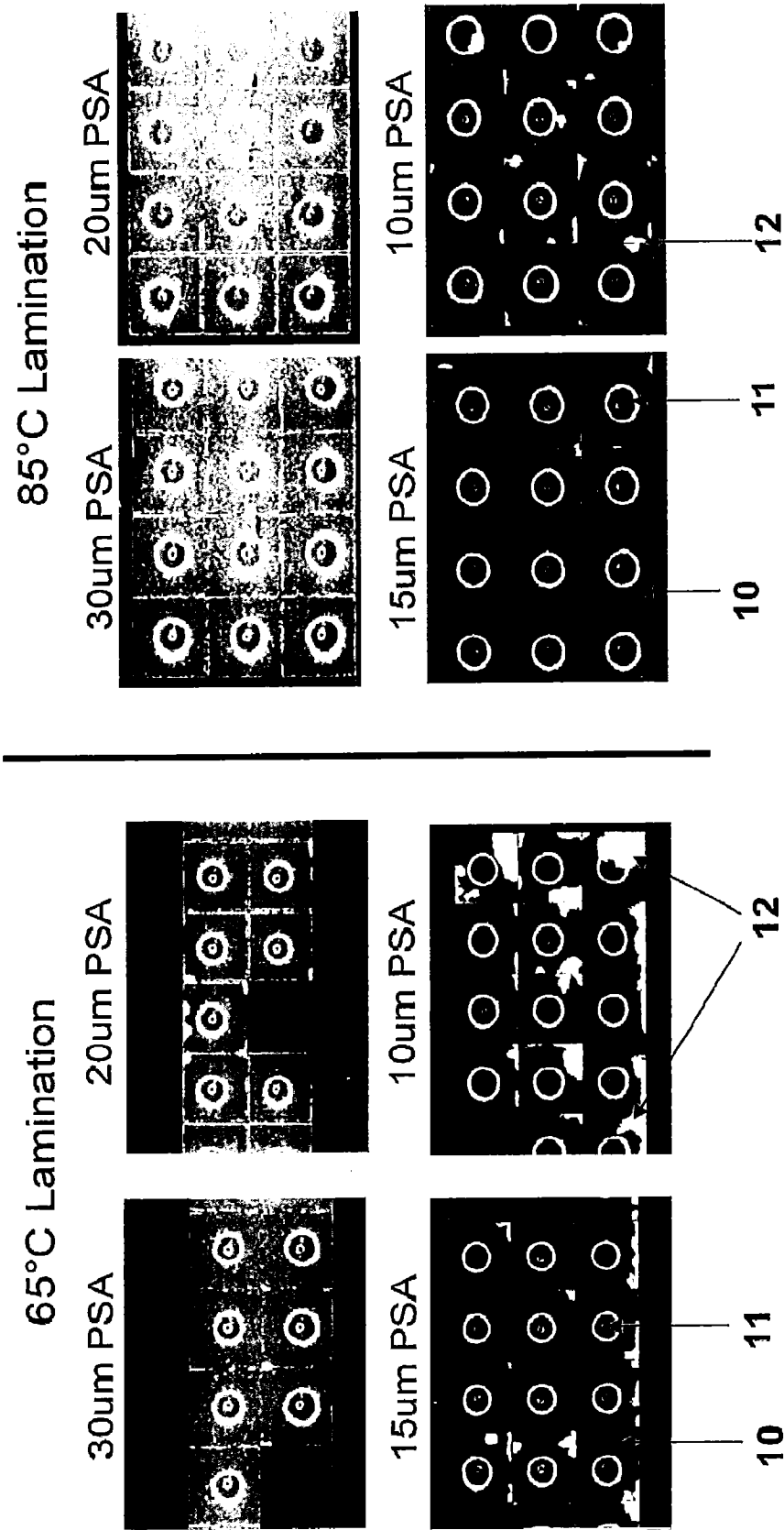
[0022] The die attach adhesive was picked off the dicing tape under the following conditions: 0.5mm needle height; 10msec delay; and at 110°C and 250g pressure for 100msec. The dicing tape was then inspected to determine if any die attach adhesive remained on the pressure sensitive adhesive of the dicing tape.

[0023] The results are shown in Figure 1, which contains optical microscope pictures of the dicing tape after removal of the die attach adhesive. Conductive die attach adhesive film shows as light colored areas 12. The pictures show the following results. When lamination was performed at 65°C, the 10 μm , 15 μm , and 20 μm thick dicing tapes did not compensate for the uneven surface of the conductive die attach adhesive film, and adhesive film was not completely removed from the dicing tape; however, the 30 μm thick dicing tape did release the conductive die attach adhesive film cleanly. When lamination was performed at 85°C, the conductive die attach adhesive film was not completely removed from the 10 μm thick dicing tape, but was removed cleanly from the 15 μm , 20 μm , and 30 μm thick dicing tapes

CLAIMS

1. A dicing tape comprising a carrier and a pressure sensitive adhesive in which the thickness of the pressure sensitive adhesive is 15 μ m to 50 μ m.
2. A dicing tape comprising a carrier and a pressure sensitive adhesive in which the thickness of the pressure sensitive adhesive is 15 μ m to 30 μ m.

FIGURE 1



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/065984**A. CLASSIFICATION OF SUBJECT MATTER****C09J 7/02(2006.01)i, H01L 21/60(2006.01)1**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C09J 7/02; H01L 23/48; H01L 21/301; H01L 21/52; B32B 7/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: dicing tape, carrier, pressure sensitive adhesive, thickness, wafer

c. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2002-235055 A (NITTO DENKO CORP.) 23 August 2002 See abstract; paragraphs [0013], [0029], [0037], [0051]; figure 1	1, 2
X	US 2006-0257651 A1 (SHINTANI, TOSHIO et al.) 16 November 2006 See abstract; paragraphs [0036], [0045]; figure 1	1, 2
X A	JP 2008-159998 A (NITTA IND. CORP.) 10 July 2008 See abstract; paragraphs [0008], [0029]; figure 1	1 2
A	JP 2011-198797 A (HITACHI CHEM CO., LTD.) 06 October 2011 See abstract; paragraph [0014]	1, 2
A	US 2007-0120271 A1 (KOZAKAI, SHOUHEI et al.) 31 May 2007 See abstract; paragraph [0028]; claim 1	1, 2



Further documents are listed in the continuation of Box C.



See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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