



BEIERSDORF AG

THIS SHEET HAS BEEN
REPLACED

Description

Self-adhesive tape (dicing tape) which can be partially detackified by radiation

The invention relates to a self-adhesive tape (a so-called dicing tape) which can be partially detackified by radiation, as is used for the temporary fixing of wafers and the like during the machining thereof.

In the manufacture of chips, before the individual switching elements and conductor tracks can be produced on the wafer, the wafer must initially be very even. This is achieved by grinding, during which fixing and protection is necessary, as offered by a so-called dicing tape. Adhering to this tape, the wafer thus pretreated is subjected to certain processes in order to cross the actual switching elements and conductor tracks. These processes are predominantly those of photolithography. Subsequently, the pretreated wafer is sawn up in order to obtain the individual chips. For the sawing operation, too, the wafer must be fixed, generally using a dicing tape which at the beginning has a defined initial adhesive strength which, once the sawing operation has been carried out, is carefully reduced in order to separate the chips. Small chips are separated by piercing the reverse side with a spike and then lifting them off with a suction die. In the case of relatively large components, this procedure cannot be used because of the risk of the chips disintegrating. In this case a dicing tape is needed in which the adhesive strength after sawing must be able to be carefully reduced so that piercing with a spike is unnecessary.

Such dicing tapes are already known. For instance, EP-A-157 508 describes a thin self-adhesive tape which is intended for use in the machining of semiconductor wafers and whose adhesive composition comprises a photosensitizer which is admixed subsequently. The adhesive strength of this tape with wafers stuck onto it can be reduced by extension and UV radiation such that the wafers can be taken off again



from the tape with appropriate grippers/suction tubes.

EP-A-298 448 also discloses such a radiation-crosslinkable self-adhesive tape in which cyanurates and isocyanurates are used in the adhesive composition in order to improve the UV crosslinking and therefore the
5 desired depression of adhesive strength.

In addition, self-adhesive tapes are already known from DE-C-2 743 979 which have a crosslinked polyacrylate adhesive composition which comprises, incorporated by polymerization, a photoinitiator so that
10 the adhesive composition, after coating on the adhesive-tape support, can be crosslinked in a targeted manner by UV radiation into the state of a broad-meshed linked-chain structure which is stable to after-crosslinking and
15 is typical of self-adhesive compositions (col. 2, lines 23-28).

Products of this prior art, however, have disadvantages which are serious for the envisaged purpose of wafer machining.

20 Wafers, as semiconductors for electronic applications, are produced from materials of extraordinary purity. They are subject to specific requirements which make it necessary to treat these wafers with the utmost care, not only mechanically but also chemically. At every
25 contact with foreign materials it must be ensured that no migratable components of low molecular weight are able to pass onto or into the wafer. Such impurities would restrict the use of the wafer or make it totally impossible. In addition, there are toxicological concerns when
30 working with corresponding adhesive compositions, since at such highly specialized workplaces these materials are handled daily and over long periods.

Incitements to the application envisaged here, however, could not be obtained from DE-C-2 743 979, since
35 in that document the intention of the UV irradiation envisaged was actually just to create typical self-adhesive compositions (col. 2, lines 23-28), whereas the purpose here is to obtain a drastic depression of the adhesive strength, just as a dicing tape cannot be



compared with a typical self-adhesive tape. Moreover, the self-adhesive compositions according to DE-C-2 743 979 cannot be detackified by irradiation. Instead, they reach a boundary value of crosslinking which is not exceeded even by prolonged irradiation. During such treatment, the tackiness is retained with virtually no change.

The problem posed is solved with a dicing tape as characterized in more detail in the claims.

With this tape, advantages surprising to the person skilled in the art are obtained in the machining of wafers. The covalent incorporation of the photosensitizers in self-adhesive compositions gives rise even during copolymerization to a homogeneous product which enables the manufacture of the dicing tape according to the invention. By this means the desired crosslinking, which leads to the depression of adhesive strength, is also particularly uniform and efficient. This also applies when films of moderate transparency to radiation are used. Moreover, the profile of adhesive strength can be established specifically, before and after crosslinking, both by the monomer combination and by the intensity and duration of radiation. This profile of adhesive strength is advantageously determined by the targeted incorporation of crystalline and/or amorphous polymer segments in the copolymer. It is particularly advantageous to use long-chain acrylic esters, such as stearyl acrylate, for example, whose side-chain crystallinity contributes in particular to the adhesion properties. The subsequent addition of reactive and toxic compounds of low molecular weight for crosslinking is not only unnecessary but is deliberately avoided in the interest of keeping the wafer clean.

Support materials which can be employed are both the customary halogen-containing films, such as PVC, for example, and halogen-free films, which offer distinct advantages from an ecological standpoint. The films can be either single layers or multilayer laminates, but are preferably single-layer. Because of the selective nature of the UV initiators, the incorporation of specific UV



filters into the film system is superfluous.

Suitable support materials are all radiation-permeable, especially UV-permeable films which may be composed either of homopolymers or of copolymers, such as, for example, polyethylene, polypropylene, PVC, polyesters or ethylene-vinyl acetate copolymers, preferably films having a high elastic component, such as flexible PVC and polybutene or 1,2-polybutadiene or ethylene-butyl acrylate copolymers as halogen-free variants. Certain flexible PVC and ethylene-butyl acrylate copolymer types offer the advantage that extensions of up to 800 % uniformly in the X and Z direction can be realized. The thicknesses of the films are in particular between 5 and 400 μm , preferably between 20 and 80 μm . The use of an ethylene-butyl acrylate copolymer as support material in combination with a polyacrylate copolymer as adhesive composition has proved to be particularly favourable in the context of anchoring the adhesive composition.

The polymerization can be carried out with all commercially customary initiator systems, especially with free-radical initiators, such as peroxides, azo compounds and dicarbonates, e.g. benzoyl peroxide, di-tertiary-butyl peroxide, diamyl peroxide, azobisisobutyronitrile, 2,2'-azobis-(2-methylbutyronitrile), bis(4-t-butylcyclohexyl) peroxydicarbonate and diacetyl peroxydicarbonate. Dibenzoyl peroxide is particularly preferred.

These compounds can be employed either alone or as mixtures.

The depression of adhesive strength prior to the removal of the sawn chips from the dicing tape is accomplished by radiation-crosslinking, especially by UV irradiation. The UV sensitizers used in this context are compounds in which the UV-sensitive groups are attached to polymerizable units. Examples hereof are 2-oxo-1,2-diphenyl-ethyl 2-propenoate (benzoin acrylate) and 4-(2-acryloyloxyethoxy)-phenyl 2-hydroxy-2-propyl ketone, with benzoin acrylate being preferred. These photosensitizers are employed in particular in amounts of 0.1-5 % by



weight, preferably 1-3 % by weight.

These compounds, too, can be employed either alone or as a mixture.

Suitable monomers for the synthesis of the adhesive system are acrylic acid and acrylic esters of the type $H_2C=CR_1-CO-OR_2$, with definitions as follows

$R_1 = H$ or $-CH_3$, $R_2 = C1-C24$ with linear and branched carbon chains in the ester unit, ethyldiglycol, 4-t-butylcyclohexyl, 2-hydroxyethyl, hydroxypropyl, hydroxybutyl, dimethylaminoethyl, preferably n-butyl to stearyl.

Corresponding variants based on methacrylic acid and methacrylic esters are, likewise, suitable.

Vinyl acetate and various vinyl alkyl ethers of the type

$H_2C=CH-O-R$ where

$R =$ methyl, ethyl, propyl, isobutyl, octadecyl, cyclohexyl, 4-hydroxybutyl can also be employed, as can vinylpyrrolidone, vinylcaprolactam, vinylcarbazole and 1-vinylimidazole.

Example

Polymer preparation:

192 g of 2-ethylhexyl acrylate, 200 g of stearyl acrylate, 8 g of benzoin acrylate and 266 g of acetone were placed in a 2-litre polymerization apparatus made of glass or steel, fitted with stirrer, reflux condenser, thermometer and gas inlet pipe. The solution was first of all freed from oxygen by flushing with nitrogen while stirring (about 120 rpm), and then heated to boiling.

By addition of a total of 0.4 % by weight of dibenzoyl peroxide in portions, the polymerization was initiated and continued. During the polymerization period of about 20 hours, the batch was diluted a number of times, depending on the viscosity, with solvent (benzine 60/95) so that the final polymer solution had a solids content of 30 - 60 % by weight.

Yield [%]: 99.4



K value: 83.1

Coating:

The polymer solution described above was used subsequently as follows.

- 5 Support: EBA film, 70 μ m thick.

1st operation

One-sided corona pretreatment to improve anchoring of the composition at 1.85 kW at 10 m/min (corresponds to about 38 mN/m)

- 10 **2nd operation**

As soon after the corona treatment as possible, the composition was applied to this pretreated side (speed: 1 m/min; weight of composition: about 10 - 15 g/m², drying in six zones: 60/70/70/80/80/90°C). The
15 coated tape was covered with release film/release paper.

3rd operation

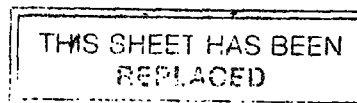
The finished tape was subjected on the film support side to EB irradiation (170 kV at a speed of 4-5 m/min, in order to obtain a dose of about 10 kGy), in
20 order to improve the profile of properties of the film and the anchoring of the adhesive composition.

Product properties:

The dicing tape produced in the manner described above has an initial adhesive strength on a silicon wafer
25 of 1.1 N/cm.

After UV irradiation (stationary; 30 sec Hanau Q 1200) the adhesive strength of the sample falls to 0.15 N/cm.

Commercially customary UV irradiation sources
30 were employed for the irradiation. After the customary method of extension of the tape with the wafers stuck onto it and UV irradiation as described, the wafers can be taken off readily and without damage.



Test methods:

K value:

5 The K-value was determined by the customary methods of capillary viscometry (in Ubbelohde viscometers). The measurements were carried out on solutions of 1 g of polymer in 100 ml of toluene at 25°C.

Adhesive strength:

10 The rough side of the wafer surface (unpolished side) was stuck onto the non-irradiated test strip (width: 20 mm). It was applied without air bubbles. Subsequently, the tape was pressed on carefully by hand. Measurement was carried out with an electronic tensile testing machine within one minute of application (peel angle: 180°C, peel rate: 300 mm/min).

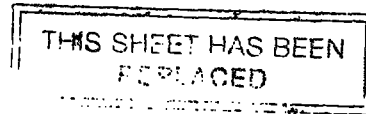


Patent Claims

1. Self-adhesive tape (dicing tape) which can be partially detackified by radiation for the temporary fixing of wafers, with a support comprising a radiation-permeable film and a radiation-crosslinkable self-adhesive composition, characterized in that the polymeric self-adhesive composition comprises radiation sensitizers in copolymerized form.
2. Self-adhesive tape according to Claim 1, characterized in that the radiation is UV radiation, the support film being UV-permeable, the self-adhesive composition being UV-crosslinkable and the copolymerized sensitizers being UV-sensitizers.
3. Self-adhesive tape according to Claim 2, characterized in that the copolymerized sensitizer is benzoin acrylate.
4. Self-adhesive tape according to Claim 1, characterized in that the support film consists of flexible PVC, polybutene, 1,2-polybutadiene or ethylene-butyl acrylate copolymer.
5. Self-adhesive tape according to Claim 1, characterized in that the support film can be extended in both of its planar directions at a film thickness of 5 - 400 μm , especially 20 - 80 μm .
6. Self-adhesive tape according to Claim 1, characterized in that the support film is an ethylene-butyl acrylate copolymer and the self-adhesive composition is a polyacrylate copolymer.
7. Self-adhesive tape according to Claim 1, characterized in that the self-adhesive composition is a polyacrylate copolymer with side-chain crystallinity.
8. Use of a self-adhesive tape (dicing tape) according to one of Claims 1-7 for the temporary fixing of wafers.
9. Use according to Claim 8, characterized in that the wafers are removed again by irradiating the self-adhesive tape through the support in order to crosslink the self-adhesive composition and thereby to reduce the



This Sheet Has Been Replaced



- 9 -

adhesive strength, after which the wafers can be taken off with suction tubes or the like.



* C L M S *