produced by the transfer of a layer from the donor substrate to a carrier substrate, for example during a SmartCut® step. Thus, the occurrence of quality defects leads in some instances to production scrap.

Object of the invention

Taking account of the foregoing, an object of the present invention is to provide a donor substrate fabricating process which may increase the production quality of the donor substrates, and may lead to the reduction in the occurrence of defects, in particular the occurrence of defects observed on the final multi-layer substrates.

Brief description of the invention

A first aspect of the invention relates to a process for fabricating a donor substrate, comprising the steps of A: providing a handle substrate, B: providing a target substrate, C: attaching the target substrate to the handle substrate, comprising bonding by way of an adhesive layer, the adhesive layer being a layer of a photo-polymerizable material, in particular a layer of a photo-polymerizable liquid with a thickness of 3 µm to 8 µm, and D: rectifying, in particular by grinding, the target substrate attached to the handle substrate, so as to form the donor substrate. The process is characterized in that a waiting period of a predetermined duration is observed between step C and step D.

According to an unexpected discovery of the inventors, the implementation of a waiting period of a predetermined duration between steps C and D may lead to a significant reduction in the quantity of cracks observed in the multi-layer substrates produced from donor substrates fabricated by the process that forms the subject matter of the invention. Specifically, the waiting period may allow the constituent elements of the non-rectified donor substrate to rest and improve in robustness. In particular, the stabilizing effect of the adhesive layer of the photo-polymerizable material for the attachment in step C may be amplified. Thus, the non-rectified donor substrate may be rendered more resistant to the mechanical stresses incurred during the following rectification, and during a subsequent layer transfer step. Consequently, the proportion of multi-layer substrates, fabricated from donor substrates, having a risk of cracking may be reduced and the overall quality of the production of multi-layer substrates may be increased. For example, by reducing the quantity of cracks at the edge of the substrate, the surface area or the radius of a usable substrate may be increased.

According to one embodiment of the first aspect of the invention, the target substrate is a piezoelectric substrate, in particular a piezoelectric substrate comprising a material selected from among quartz,

lithium tantalate, lithium niobate, aluminium nitride, zinc oxide, gallium orthophosphate, barium titanate, langasite, langanite, gallium nitride, lead zirconate titanate or langatate.

Thus, the DVS obtained by the process may be used to fabricate POI substrates. Since piezoelectric substrates are particularly valuable due to their high price and diverse applicability, a reduction in the production scrap by the inventive process may be all the more advantageous.

According to one embodiment of the first aspect of the invention, the handle substrate comprises a material selected from among silicon, sapphire, aluminium nitride, silicon carbide or gallium arsenide.

By selecting one of these materials, the thermal expansion coefficient of the handle substrate may be advantageously adapted to a subsequent use of the DVS for the fabrication of a multi-layer substrate.

According to one embodiment of the first aspect of the invention, the predetermined duration is at least 24 h, preferentially at least 48 h, and preferably at least 105 h.

By selecting the predetermined duration in this way, it is possible to obtain particularly great gains in quality of substrates produced. For example, it is possible to obtain rates of cracking of 20% or less, 10% or less or 5% or less respectively on the multi-layer substrates obtained from donor substrates fabricated by the process according to this aspect of the invention.

According to one embodiment of the first aspect of the invention, the predetermined duration is less than 300 h, preferentially less than 200 h, and preferably less than 150 h.

By limiting the duration of the waiting period in this way, it is possible to maintain a good balance between gain in production quality and reduction in production throughput. According to one aspect of the invention, the predetermined duration is determined as a function of the material of the adhesive layer.

The waiting period may thus be adapted to the adhesion and relaxation properties specific to each adhesive layer material. In particular, this may make it possible to precisely adapt the waiting period required to obtain a gain in quality of substrates produced.

According to one embodiment of the first aspect of the invention, the predetermined duration is selected, on the basis of a statistical study formulating a rate of cracking observed on multi-layer substrates obtained from the donor substrates fabricated by this process according to the duration of the observed waiting period, such that said duration corresponds to the duration required to obtain a rate of cracking of 20% or less, in particular of 10% or less, or even more

particularly of 5% or less. In particular, the statistical study may result from tests comprising at least 500 fabricated donor substrates, for example in the form of wafers.

By basing the duration of the waiting period on such a statistical study, it is possible to adapt the process even more precisely to a desired quality objective of the donor substrate produced.

According to one embodiment of the first aspect of the invention, the waiting period is observed under ambient conditions. The costs and the footprint for environmental control equipment are thus avoided and the effect of the invention can be obtained.

A second aspect of the invention concerns a process for transferring a layer from a donor substrate to a carrier substrate, comprising the steps of A: providing a donor substrate obtained by the implementation of the fabrication process described above, B: forming a weakened zone in the target substrate so as to delimit the layer of the target substrate to be transferred, C: providing a carrier substrate, notably comprising a material corresponding to a material of the handle substrate, D: attaching the donor substrate to the carrier substrate, and E: fracturing and separating the donor substrate along the weakened zone.

The implementation of this process may make it possible to obtain a multi-layer substrate with a reduced occurrence of material defects, as elaborated above: by implementing a waiting period of a predetermined duration, the quality of the obtained donor substrates may be increased. Consequently, the layer of the target substrate that is transferred to the carrier substrate is also of a higher quality.

The combination of the process for fabricating a donor substrate with this process for transferring a layer from a donor substrate is particularly advantageous because the fractured donor substrate, that is to say the remainder of the donor substrate remaining after step E, can be reused. Thus, for example in the context of a “refresh” of a process of the SmartCut® type, it is possible for the same residual donor substrate to be prepared, in a subsequent production cycle, for transferring another layer of the target substrate to another carrier substrate.

Brief description of the drawings

The objects, features and advantages of the invention as outlined above will be more exhaustively understood and appreciated upon studying the more detailed description below concerning the invention, and upon studying the appended drawings.