Method and Device for Sawing a Workpiece

The invention relates to a device and to a method for sawing a workpiece.

In order to saw a workpiece by slicing a multiplicity of wafers from this workpiece, wire saws are for example used.

Wire saws are suitable in particular for slicing a multiplicity of semiconductor wafers, solar wafers and other crystal wafers from a crystal piece in one working step.

The functional principle of such a wire saw is described in US-5,771,876.

Wire saws have a wire gang, which is formed by a sawing wire which is wound around two or more wire feed or guide rolls.

The sawing wire may be covered with a cutting layer.

When using wire saws having a sawing wire without firmly bound cutting abrasive, cutting abrasive in the form of a suspension (slurry) is supplied during the slicing process.

During the slicing process, the workpiece fastened on a table passes through the wire gang, in which the sawing wire is arranged in the form of wire sections lying parallel to one another. The passage through the wire gang is brought about by means of a relative movement between the table and the wire gang, induced by means of a forward feed device, which feeds the workpiece against the wire gang (table forward feed) or the wire gang against the workpiece.

Conventionally, the workpiece is connected to a sawing strip, into which the sawing wire cuts after having sliced through the

workpiece.

The sawing strip may for example be a graphite strip, which is adhesively bonded or cemented onto the circumferential surface of the workpiece. Lastly, the workpiece with the sawing strip is cemented onto the table.

After the slicing, the sliced wafers remain fixed on the sawing strip like the teeth of a comb and thus can be taken out of the wire saw. Subsequently, the remaining sawing strip is removed from the wafers.

It has been found that in the case of wire sawing, sawing grooves (sawing tracks) occur on the sliced wafers in the region of the wire exit.

Since no method making it possible to avoid these sawing grooves is known in the prior art, it was an object of the inventors to provide such a method.

The object of the invention is achieved by a method for sawing a workpiece, in which the workpiece is fed through a wire gang formed by a sawing wire, characterized in that kerfs of the workpiece are filled with sawing suspension during the sawing process.

The workpiece is preferably immersed into a reservoir which is filled with the sawing suspension, so that the kerfs of the workpiece become filled with sawing suspension.

The sawing suspension preferably contains an abrasive and a carrier liquid.

The invention also relates to a device that is suitable for sawing a workpiece, which comprises a wire gang formed by a

sawing wire, a forward feed instrument holding the workpiece to be sawed and feeding the workpiece in the direction of the wire gang, as well as a reservoir filled with a sawing suspension, the reservoir being arranged and filled such that at least the part of the sawing wire which is in engagement during the sawing process is respectively immersed into the sawing suspension of the reservoir.

The inventors have discovered that after sawing suspension is applied onto the sawing wire according to the prior art, demixing of the sawing suspension takes place in the sawing kerf. This demixing of the sawing suspension is intended to mean that the sawing suspension is separated into the constituents abrasive (for example silicon carbide, SiC) and the carrier liquid (for example glycol).

The inventors have furthermore established that the observed sawing grooves are attributable to this demixing of the sawing suspension in the sawing kerf.

The demixing of the sawing suspension can be avoided by the method according to the invention.

This is achieved according to the invention, when using a device according to the invention, in that the sawing kerfs are filled with sawing suspension during the slicing process, preferably by the workpiece to be sawed being immersed into the reservoir filled with a sawing suspension, the reservoir being filled from below.

The sawing suspension is in this case preferably supplied via one or more nozzles fitted on the bottom of the reservoir. This prevents sedimentation of the abrasive.

The end sides of the reservoir, which lie parallel to the wire

running direction, are preferably configured so that they protrude beyond the upper edges of the side faces of the reservoir. This ensures that the sawing suspension flows out of the reservoir parallel to the wire running direction, i.e. the flow lines of the sawing suspension flowing out extend parallel to the wire running direction.

The shape of the reservoir and the nozzle(s) on the bottom of the reservoir are configured so that a maximally laminar flow of the sawing suspension is formed in the trough. This is preferably achieved by various perforated plates, which produce a uniform pressure distribution in the sawing suspension at the bottom of the reservoir.

Owing to the fact that the entire sawing kerf is filled with sawing suspension, demixing of the sawing suspension is prevented. This is based on the fact that the concentration gradient of the liquid of the sawing suspension between the sawing kerf and the surroundings is smaller. The carrier liquid remains in the sawing kerf and is transported with the wire.

Owing to this, no depletion of abrasive takes place at the wire exit. The sawing grooves (sawing tracks) formed in the prior art are therefore avoided.

Another advantage of the invention is that uniform thermal regulation of the entire workpiece can be ensured throughout the method. Negative temperature effects can therefore likewise be avoided.

Compared with the prior art, a sawing suspension or slurry circuit can furthermore be obviated.

DE 19841492 A1 discloses a wire saw using a sawing suspension with firmly bound abrasive (without supplying a sawing

suspension), and provides a container filled with a coolant, for example water, into which the rod is immersed during the sawing. Optimal cooling of the kerfs is thereby intended to be achieved. The device described therein is thus intended to achieve an object very different to that of the present invention.

The invention will be illustrated below with the aid of a figure.

Fig. 1 schematically shows a preferred embodiment of the device according to the invention.

Fig. 1 shows four wire feed rolls, around which the sawing wire is wound. A wire gang is thereby formed. The workpiece is fastened on a support plate and is fed from below in a forward feed direction through the wire gang. Also represented is a reservoir, which is filled with a sawing suspension. A nozzle, via which the sawing suspension is supplied into the reservoir, is fitted on the bottom of the reservoir. The workpiece is immersed progressively into the sawing suspension. This ensures that the sawing kerfs are filled with sawing suspension throughout the method.

Patent Claims

1. A method for sawing a workpiece, in which the workpiece is fed through a wire gang formed by a sawing wire, characterized in that kerfs of the workpiece are filled with sawing suspension during the sawing process.

2. The method as claimed in claim 2, wherein the workpiece is immersed into a reservoir which is filled with the sawing suspension.

3. The method as claimed in claim 2, wherein the sawing suspension contains an abrasive and a carrier liquid.

4. The method as claimed in claim 1, wherein the sawing suspension flows out of the reservoir parallel to the wire running direction.

5. The method as claimed in claim 2, wherein the reservoir is arranged and filled such that at least the part of the sawing wire which is in engagement during the sawing process is respectively immersed into the sawing suspension of the reservoir, so that the kerfs of the workpiece become filled with sawing suspension.

6. The method as claimed in claim 2, wherein the sawing suspension is supplied via one or more nozzles fitted on the bottom of the reservoir.

7. The method as claimed in claim 2, wherein end sides of the reservoir, lying parallel to a wire running direction, protrude beyond the upper edges of the side faces of the reservoir.

8. A device suitable for sawing a workpiece, which comprises a wire gang formed by a sawing wire, a forward feed instrument

holding the workpiece to be sawed and feeding the workpiece in the direction of the wire gang, as well as a reservoir filled with a sawing suspension, the reservoir being arranged and filled such that at least the part of the sawing wire which is in engagement during the sawing process is respectively immersed into the sawing suspension of the reservoir.