Saw wire and method for the cutting lapping of hard brittle workpieces

The invention relates to a saw wire for the simultaneous cutting lapping of a multiplicity of wafers from a hard brittle workpiece. The invention also relates to a method for cutting lapping using a saw wire.

A wire saw which is suitable in particular for the production of semiconductor wafers, and the operating principle on which a wire saw is based, are described, for example, in US 5,771,876.

Generally, wire saws are equipped with wire-guide rollers, over which an endless saw wire is guided helically, so that a saw harp or a cutting or wire web is formed. The workpiece is guided through the wire web by an advancing movement and is split into wafers when it passes through the web. The saw wire is either moved in the same direction over the entire cutting run or is moved to and fro (oscillating wire movement). The cutting-lapping agent used is abrasive grains of different grain sizes and different hardnesses, which are suspended in a carrier liquid.

The quality of the cut, i.e. the quality of the wafer surfaces and the wafer geometries is dependent in the first instance on uniform distribution of the cutting-lapping agent along the width of the web. However, saw wires according to the prior art generally do not carry the amount of cutting-lapping agent which is available on the wire web optimally into the cutting gap.

The object of the invention is to avoid the abovementioned drawbacks of the prior art, to improve the geometry of the wafers and surface parameters, such as the striations, roughness and rippling, and to shorten the process times.

The object is achieved by means of a method for

18 NOV 2002

the simultaneous cutting lapping of a multiplicity of wafers from a hard brittle workpiece using a saw wire which runs helically over wire-guide rollers and forms a wire web, and a cutting-lapping agent in a wire saw, wherein the saw wire executes a rotary movement during the cutting lapping.

Surprisingly, it has been found that the use of a saw wire with a defined torsion leads to a rotation of the wire during the cutting lapping. This rotary movement, which is similar to a boring movement, promotes the distribution of the cutting-lapping agent on the wire web and in particular the supply of cutting-lapping agent to the cutting gap. Preferably, the saw wire rotates while it is being guided over the wire web. The saw wire preferably rotates 1 to 10 times, particularly preferably 2 to 5 times, over a wire length of 1500 mm.

Accordingly, the object of the invention is also achieved by means of a saw wire for the simultaneous cutting lapping of a multiplicity of wafers from a hard brittle workpiece, wherein the saw wire exhibits torsion.

The torsion of the saw wire is generated by the wire being turned about its own axis, for example by oppositely directed rotation from the two ends. Preferably, the torsion of the saw wire can be generated by rewinding using an unwinding arm, for example by a saw wire according to the prior art being unwound from a wire reel by means of an unwinding device, known as a flyer, and being wound back onto a saw wire reel vertically or horizontally. This unwinding and rewinding results in a defined torsion being imparted to the saw wire. The saw wire reel bearing the saw wire according to the invention is then used as a so-called source or dispenser reel in a wire saw according to the prior art.

However, it is also preferable to use a wire saw reel having a saw wire in accordance with the prior art as a source or dispenser reel in a wire saw and to turn the saw wire by means of a twisting device. The twisting

device is expediently positioned in front of or behind the wire web.

Over a saw wire length of preferably 150 to 1500 mm, particularly preferably from 300 to 1000 mm, the torsion of the saw wire amounts to 360°. Over a wire length of preferably 150 to 1500 mm, and particularly preferably of 300 to 1000 mm, a saw wire is turned through 360° by means of a twisting device. Expediently, the twisting device is positioned in front of or behind the wire web. The saw wires used are coated or uncoated wires with a thickness of from 80 to 500 μm and a tensile strength of >2000 N/mm^2.

The rotation of the saw wire according to the invention during the cutting lapping, in particular of hard brittle workpieces, leads to an improved surface quality of the wafers, in particular to a reduced roughness and rippling. Furthermore, improved geometry characteristics (wedge effect) and shortened process times are achieved.

Example:

The figure shows the performance of the saw wire according to the invention and of the method on the basis of the roughness distribution.

Quality fluctuations with regard to the cut-lapped wafer surfaces and wafer geometries are reduced by the use of the saw wire according to the invention. The roughness of the surface of a wafer of a cut-lapped semiconductor ingot was determined at 5 measurement points using a perthometer. The mean was formed from the 5 measured values. This mean is shown as a point in the figure. The surfaces of the wafers which were produced by means of cutting lapping using a saw wire according to the prior art have a roughness distribution of between 0.40 and 0.60 μm (shown on the left). The surfaces of the wafers which were produced by means of cutting lapping using the saw wire according to the invention no longer

exhibit any roughness distribution. The roughness is constant and is approximately 0.32 µm (shown on the right). The saw wire according to the invention had a torsion of 360° over a wire length of 700 mm and was used in a wire saw according to the prior art.

The saw wire according to the invention is advantageously used in wire saws for the cutting lapping of hard brittle workpieces, in particular semiconductor ingots.

Patent Claims

1. A method for the simultaneous cutting lapping of a multiplicity of wafers from a hard brittle workpiece using a saw wire which runs helically over wire-guide rollers and forms a wire web, and a cutting-lapping agent in a wire saw, wherein the saw wire executes a rotary movement during the cutting lapping.

2. A saw wire for the simultaneous cutting lapping of a multiplicity of wafers from a hard brittle workpiece using a cutting-lapping agent in a wire saw, wherein the saw wire exhibits torsion, wherein the torsion over a wire length of 150 to 1500 mm amounts to 360 °.