

of the wire guide rolls and of the bearings of the wire guide rolls is changed as a result of heat transport.

US 2002/0174861 A1 describes a method which provides  
5 for regulating the temperature of the workpiece during the sawing operation.

US 2010/0089377 A1 proposes a method in which the displacement of the workpiece in an axial direction is  
10 measured and the axial displacement of the wire guide rolls is regulated in such a way that it corresponds to that measured. The regulation of the axial displacement of the wire guide rolls is effected, according to one example, by cooling water being conducted through the  
15 shafts of the wire guide rolls and by adaptation of the temperature and/or flow rate of the cooling water. Furthermore, it is proposed to record a curve showing the displacement of the workpiece as a function of the cutting depth, and to regulate the displacement of the  
20 wire guide rolls on the basis of the curve.

The inventors of the present invention have ascertained that, over and above the solutions offered by the prior art, there is a need for improvements in order to  
25 reduce or prevent an axial relative movement of the wire sections and of the workpiece that is caused by changes in temperature.

An aspect of the The present invention relates to a method  
30 for slicing wafers from a workpiece, comprising during a sawing operation moving wire sections - arranged in a parallel fashion - of a sawing wire relative to the workpiece, thus giving rise to the wafers, wherein the wire sections are tensioned between wire guide rolls  
35 each having a grooved coating having a specific thickness; ~~and~~ cooling the wire guide rolls and cooling the fixed bearings of the wire guide rolls, wherein the wire

guide rolls and the fixed bearings are cooled from  
inside and independently of one another. The method  
further comprises measuring an axial change in the  
length of the coating of one of the wire guide rolls  
5 during the sawing operation; generating a first and a  
second regulation signal on the basis of the  
measurement; and regulating the cooling of the wire  
guide rolls by means of the first regulation signal and  
regulating the cooling of the fixed bearings of the  
10 wire guide rolls by means of the second regulation  
signal.

The wire guide rolls and the fixed bearings thereof are  
cooled from inside and independently of one another in  
15 order to reduce or completely prevent an axial relative  
movement of the workpiece and of the wire sections  
during the sawing operation. For this purpose,  
dedicated cooling circuits are in each case set up,  
through which coolant is in each case conducted, the  
20 properties of which are coordinated with the cooling of  
the wire guide rolls and of the fixed bearings,  
respectively.

In contrast to known solutions, the present invention  
25 takes account of the fact that said axial relative  
movement is substantially to be attributed to changes  
in the temperature of the workpiece, of the respective  
fixed bearing and of the coating of the respective wire  
guide roll. It takes account of the fact, in  
30 particular, that the changes in the length of the  
coating and of the fixed bearing of the respective wire  
guide roll that are brought about by changes in  
temperature are different and, from this insight, draws  
the conclusion that it is more advantageous if the  
35 temperature of the respective wire guide roll, in  
particular the temperature of its coating, and the  
temperature of the fixed bearing of the respective wire  
guide roll are controlled in a manner independent of  
one another.

The change in the length of the workpiece during the sawing operation is dependent on the length of the workpiece before the sawing operation, and on the amount of heat that arises during the sawing operation.

- 5 The latter is dependent on the process conditions chosen, which are described by a totality of different

# Patent claims

1. A method for slicing wafers from a workpiece, comprising  
5 during a sawing operation moving wire sections - arranged in a parallel fashion - of a sawing wire relative to the workpiece, thus giving rise to the wafers, wherein the wire sections are tensioned between wire guide rolls each having a grooved coating having a  
10 specific thickness; and cooling the wire guide rolls and cooling the fixed bearings of the wire guide rolls, wherein the wire guide rolls and the fixed bearings are cooled independently of one another.  
15
2. The method as claimed in claim 1, comprising cooling the wire guide rolls and the fixed bearings in such a way that at every point in time in the sawing operation the difference  $\Delta L_W(x) - (\Delta L_F + \Delta L_B(x))$  is less  
20 than 20  $\mu\text{m}$ , wherein  $\Delta L_W(x)$  is the axial displacement experienced by an axial position  $x$  on the workpiece on account of a change in the length of the workpiece that is caused by the change in the temperature of the workpiece,  $\Delta L_F$  is the change in length experienced by  
25 the fixed bearing as a result of the change in the temperature of the fixed bearing, and  $\Delta L_B(x)$  is the axial displacement experienced by the axial position  $x$  on the coating of the wire guide roll on account of a change in the length of the coating that is caused by  
30 the change in the temperature of the casing.
3. The method as claimed in claim 2, comprising reacting to an axial displacement  $\Delta L_W(x)$  that is greater than 0  $\mu\text{m}$  by cooling the wire guide rolls and  
35 the fixed bearings in such a way that the difference  $\Delta L_W(x) - (\Delta L_F + \Delta L_B(x))$  is less than 20  $\mu\text{m}$ .

4. The method as claimed in any of claims 1 to 3, comprising providing a first predefinition curve, which describes the temperature or the speed of a coolant for cooling the wire guide rolls during the sawing operation, and a second predefinition curve, which describes the temperature or the speed of a coolant for cooling the fixed bearings of the wire guide rolls during the sawing operation; and cooling the wire guide rolls and the fixed bearings in accordance with the first and second predefinition curves.

5. The method as claimed in claim 4, comprising providing the first predefinition curve as a function of the thickness of the coating of the wire guide rolls.

6. The method as claimed in any of claims 1 to 3, comprising measuring an axial change in the length of the coating of one of the wire guide rolls during the sawing operation; generating a first and a second regulation signal on the basis of the measurement; and regulating the cooling of the wire guide rolls by means of the first regulation signal and regulating the cooling of the fixed bearings of the wire guide rolls by means of the second regulation signal.

7. The method as claimed in claim 2, comprising cooling the workpiece in such a way that  $\Delta L_W(x)$  is less than 5  $\mu\text{m}$  during the sawing operation; and cooling the wire guide roll and the fixed bearing in such a way that the sum  $(\Delta L_F + \Delta L_B(x))$  is less than 25  $\mu\text{m}$  during the sawing operation.

8. The method as claimed in any of claims 1 to 7, comprising clamping the coating onto an underlying core of the wire guide rolls.

5 9. The method as claimed in any of claims 1 to 8, comprising moving the wire sections relative to the workpiece in the presence of a sawing slurry.

Patent claims

1. A method for slicing wafers from a workpiece, comprising
  - 5 during a sawing operation moving wire sections - arranged in a parallel fashion - of a sawing wire relative to the workpiece, thus giving rise to the wafers, wherein the wire sections are tensioned between wire guide rolls each having a grooved coating having a
  - 10 specific thickness;
  - cooling the wire guide rolls and cooling the fixed bearings of the wire guide rolls, wherein the wire guide rolls and the fixed bearings are cooled from inside and independently of one another;
  - 15 measuring an axial change in the length of the coating of one of the wire guide rolls during the sawing operation;
  - generating a first and a second regulation signal on the basis of the measurement; and
  - 20 regulating the cooling of the wire guide rolls by means of the first regulation signal and regulating the cooling of the fixed bearings of the wire guide rolls by means of the second regulation signal.
- 25 2. The method as claimed in claim 1, comprising cooling the wire guide rolls and the fixed bearings in such a way that at every point in time in the sawing operation the difference  $\Delta L_W(x) - (\Delta L_F + \Delta L_B(x))$  is less
- 30 than  $20 \mu\text{m}$ , wherein  $\Delta L_W(x)$  is the axial displacement experienced by an axial position  $x$  on the workpiece on account of a change in the length of the workpiece that is caused by the change in the temperature of the workpiece,  $\Delta L_F$  is the change in length experienced by the fixed bearing as a result of the change in the
- 35 temperature of the fixed bearing, and  $\Delta L_B(x)$  is the axial displacement experienced by the axial position  $x$  on the coating of the wire guide roll on account of a

change in the length of the coating that is caused by the change in the temperature of the coating.

- 5 3. The method as claimed in claim 2, comprising reacting to an axial displacement  $\Delta L_W(x)$  that is greater than  $0 \mu m$  by cooling the wire guide rolls and the fixed bearings in such a way that the difference  $\Delta L_W(x) - (\Delta L_F + \Delta L_B(x))$  is less than  $20 \mu m$ .
- 10 4. The method as claimed in any of claims 1 to 3, comprising providing a first predefinition curve, which describes the temperature or the speed of a coolant for cooling the wire guide rolls during the sawing operation, and a second predefinition curve, which  
15 describes the temperature or the speed of a coolant for cooling the fixed bearings of the wire guide rolls during the sawing operation; and  
cooling the wire guide rolls and the fixed bearings in accordance with the first and second predefinition  
20 curves.
- 25 5. The method as claimed in claim 4, comprising providing the first predefinition curve as a function of the thickness of the coating of the wire guide rolls.
- 30 6. The method as claimed in claim 2, comprising cooling the workpiece in such a way that  $\Delta L_W(x)$  is less than  $5 \mu m$  during the sawing operation; and  
cooling the wire guide roll and the fixed bearing in such a way that the sum  $(\Delta L_F + \Delta L_B(x))$  is less than  
25  $25 \mu m$  during the sawing operation.
- 35 7. The method as claimed in any of claims 1 to 6, comprising clamping the coating onto an underlying core of the wire guide rolls.

8. The method as claimed in any of claims 1 to 7, comprising moving the wire sections relative to the workpiece in the presence of a sawing slurry.