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Datasheet for the decision
of 2 December 2010

Case Number: T 1466/07 - 3.4.03

Application Number: 00926076.1

Publication Number: 1218933

IPC: H01L 21/66

Language of the proceedings: EN

Title of invention:
Method and apparatus for performing run-to-run control in a
batch manufacturing environment

Applicant:
GlobalFoundries, Inc.

Opponent:
–

Headword:
–

Relevant legal provisions:
–

Relevant legal provisions (EPC 1973):
EPC Art. 84

Keyword:
"Lack of support by the description"

Decisions cited:
–

Catchword:
–

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Beschwerdekammern   Boards of Appeal   Chambres de recours

Case Number: T 1466/07 - 3.4.03

D E C I S I O N
of the Technical Board of Appeal 3.4.03
of 2 December 2010

Appellant: GlobalFoundries, Inc.
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                         Grand Cayman KY1-1104   (KY)

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Decision under appeal: **Decision of the Examining Division of the**
                             European Patent Office posted 12 February 2007
                             refusing European patent application
                             No. 00926076.1 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: G. Eliasson
Members: V. L. P. Frank
                   P. Mühlens

Summary of Facts and Submissions

I.   This is an appeal from the refusal of application
        00 926 076 for lack of support by the description
        (Article 84 EPC 1973) and added subject-matter
        (Article 123(2) EPC 1973).

II.   As announced with the letter dated 12 November 2010 the
        appellant applicant was not represented at the oral
        proceedings before the board.

        The appellant applicant requested in writing that the
        decision under appeal be set aside and that a patent be
        granted on the basis of the main request or on the
        basis of one of the first to fifth auxiliary requests,
        all filed with the letter of 12 October 2010.

III.   Claim 1 of the main request reads:

        "1.   A method for controlling a manufacturing process
              using a hierarchical system, comprising:
              processing a first lot of semiconductor devices
              (105) using a first set of control input
              parameters;
              storing said first set of control input parameters
              in one of a plurality of hierarchical levels (602-
              678), of a control thread, said first set of
              control input parameters being available for
              processing of a second lot of semiconductor
              devices (105) subject to said control thread; the
              hierarchical levels being ordered according to the
              relative impact control thread data in each level
              will have on the processing of the second lot of
              semiconductor devices of said thread;

acquiring process data from said processing of
said first lot of semiconductor devices (105);
determining a second set of control input
parameters for a subsequent lot of semiconductor
devices (105) based upon said acquired process
data;
storing said second set of control input
parameters in one of a plurality of hierarchical
levels (602-678) of said control thread, said
first and second sets of control input parameters
being available for processing of a third lot of
semiconductor devices (105) subject to said
control thread, the hierarchical levels being
ordered according to the relative impact control
thread data in each level will have on the
processing of the third lot of semiconductor
devices of said thread, and
implementing the first and second stored sets of
control input parameters in a subsequent
semiconductor device processing sequence for the
third lot of semiconductor 25 devices (105)."

Claim 1 of the 1ˢᵗ auxiliary request reads:

"1. A method for controlling a manufacturing process
     using a hierarchical system, comprising:
     processing a first lot of semiconductor devices
     (105) using a first set of control input
     parameters;
     storing said first set of control input parameters
     in a first level of a plurality of hierarchical
     levels (602-678), of a control thread, said first
     set of control input parameters being available
     for processing of a second lot of semiconductor

devices (105) subject to said control thread; the
hierarchical levels being ordered according to the
relative impact control thread data in each level
will have on the processing of the second lot of
semiconductor devices of said thread;
acquiring process data from said processing of
said first lot of semiconductor devices (105);
determining a second set of control input
parameters for a subsequent lot of semiconductor
devices (105) based upon said acquired process
data;
storing said second set of control input
parameters in a second level of a plurality of
hierarchical levels (602-678) of said control
thread, said first and second sets of control
input parameters being available for processing of
a third lot of semiconductor devices (105) subject
to said control thread, the hierarchical levels
being ordered according to the relative impact
control thread data in each level will have on the
processing of the third lot of semiconductor
devices of said thread, data in the first
hierarchical level having a greater effect on the
process relative to data in the second
hierarchical level, and
implementing the first and second stored sets of
control input parameters in a subsequent
semiconductor device processing sequence for the
third lot of semiconductor devices (105)."

Claim 1 of the 2nd auxiliary request reads:

"1. A method for controlling a manufacturing process
     using a hierarchical system, comprising:

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processing a first lot of semiconductor devices
(105) using a first set of control input
parameters;

storing said first set of control input parameters
in a first one of three hierarchical levels (602-
678), of a control thread, said first set of
control input parameters being available for
processing of a second lot of semiconductor
devices (105) subject to said control thread; the
hierarchical levels being ordered according to the
relative impact control thread data in each level
will have on the processing of the second lot of
semiconductor devices of said thread;

acquiring process data from said processing of
said first lot of semiconductor devices (105);

determining a second set of control input
parameters for a subsequent lot of semiconductor
devices (105) based upon said acquired process
data; and

storing said second set of control input
parameters in a second one of three hierarchical
levels (602-678) of said control thread, said
first and second sets of control input parameters
being available for processing of a third lot of
semiconductor devices (105) subject to said
control thread, the hierarchical levels being
ordered according to the relative impact control
thread data each in level will have on the
processing of the third lot of semiconductor
devices of said thread.

determining a third set of control input
parameters for a subsequent lot of semiconductor
devices (105) based upon said acquired process
data; and

storing said third set of control input parameters
in a third one of three hierarchical levels (602-
678) of said control thread, said first, second
and third sets of control input parameters being
available for processing of a fourth lot of
semiconductor devices (105) subject to said
control thread, the hierarchical levels being
ordered according to the relative impact control
thread data in each level will have on the
processing of the fourth lot of semiconductor
devices of said thread;
wherein data in the first level has a greater
effect on the process than data in the second
level, and data in the second level has a greater
effect than data in the third level, and
implementing the first and second stored sets of
control input parameters in a subsequent
semiconductor device processing sequence for the
third lot of semiconductor devices (105)."

Claim 1 of the 3rd auxiliary request reads:

"1.   A method for controlling a manufacturing process
using a hierarchical system, comprising:
performing an overlay process on a first lot of
semiconductor devices (105) using a first set of
control input parameters;
storing said first set of control input parameters
in one of a plurality of hierarchical levels (602-
678), said first set of control input parameters
being available for performing an overlay process
on a second lot of semiconductor devices (105);
the hierarchical levels being arranged in order of
the relative impact each level will have on

performing said overlay process on the second lot
of semiconductor devices;
acquiring process data from said processing of
said first lot of semiconductor devices (105);
determining a second set of control input
parameters for a subsequent lot of semiconductor
devices (105) based upon said acquired process
data;
storing said second set of control input
parameters in one of a plurality of hierarchical
levels (602-678), said first and second sets of
control input parameters being available for
performing an overlay process on a third lot of
semiconductor devices (105), the hierarchical
levels being arranged in order of the relative
impact each level will have on the processing of
the third lot of semiconductor devices, and
implementing the first and second stored sets of
control input parameters in a subsequent
semiconductor device processing sequence for the
third lot of semiconductor devices (105)."

Claim 1 of the 4th auxiliary request reads:

"1.   A method for controlling a manufacturing process
      using a hierarchical system, comprising:
      processing a first lot of semiconductor devices
      (105) using a first set of control input
      parameters; and
      updating process input control parameters for
      processing semiconductor devices on a run-to-run
      basis, comprising:
      storing said first set of control input parameters
      in one of a plurality of hierarchical levels (602-

678), of a control thread, said first set of
control input parameters being available for
processing of a second lot of semiconductor
devices (105) subject to said control thread; the
hierarchical levels being ordered according to the
relative impact control thread data in each level
will have on the processing of the second lot of
semiconductor devices of said thread;
acquiring process data from said processing of
said first lot of semiconductor devices (105);
determining a second set of control input
parameters for a subsequent lot of semiconductor
devices (105) based upon said acquired process
data;
storing said second set of control input
parameters in one of a plurality of hierarchical
levels (602-678) of said control thread, said
first and second sets of control input parameters
being available for processing of a third lot of
semiconductor devices (105) subject to said
control thread, the hierarchical levels being
ordered according to the relative impact control
thread data in each level will have on the
processing of the third lot of semiconductor
devices of said thread, and
implementing the first and second stored sets of
control input parameters in a subsequent
semiconductor device processing sequence for the
third lot of semiconductor devices (105)."

Claim 1 of the 5th auxiliary request reads:

"1. A method for controlling a manufacturing process
     using a hierarchical system, comprising:

processing a first lot of semiconductor devices
(105) using a first set of control input
parameters, wherein the processing is performed by
a first stepper tool, and

updating process input control parameters for
processing semiconductor devices on a run-to-run
basis, comprising:

storing said first set of control input parameters
in one of a plurality of hierarchical levels (602-
678), of a control thread, said first set of
control input parameters being available for
processing of a second lot of semiconductor
devices (105) subject to said control thread; the
hierarchical levels being ordered according to the
relative impact control thread data in each level
will have on the processing of the second lot of
semiconductor devices of said thread;

acquiring process data from said processing of
said first lot of semiconductor devices (105);

determining a second set of control input
parameters for a subsequent lot of semiconductor
devices (105) based upon said acquired process
data; and

storing said second set of control input
parameters in one of a plurality of hierarchical
levels (602-678) of said control thread, said
first and second sets of control input parameters
being available for processing of a third lot of
semiconductor devices (105) subject to said
control thread, the hierarchical levels being
ordered according to the relative impact control
thread data in each level will have on the
processing of the third lot of semiconductor
devices of said thread, and

implementing the first and second stored sets of
control input parameters in a subsequent
semiconductor device processing sequence for the
third lot of semiconductor devices (105), wherein
the subsequent processing is performed by a second
stepper tool."

IV.   The appellant applicant argued essentially as follows:

–   The entirety of the invention as set forth in claim
      language should be assessed when taken as a whole
      and in proper context. In particular, the applicant
      offered an illustrative and illuminating example for
      the board's benefit, particularly as claimed in the
      4th auxiliary request. Claim 1 recited that a first
      lot was processed using a first set of input control
      parameters which were then stored. The stored
      parameters might then be used to control subsequent
      processing of a second lot of devices. A second set
      of control input parameters might be determined
      based upon data associated with the second lot of
      devices. A subsequently processed third lot of
      devices might be controlled by control threads based
      on the previously processed first and second lots.
      The claim language hence read upon the description
      of updating control input parameters on a run-to-run
      basis.

–   The applicant further directed the board's attention
      to the specification, which recited "exposure tool[s]
      110" and described various embodiments in terms of
      an "exposure tool 110" throughout the description
      (eg page 3, lines 12 to 31). One example of an
      "exposure tool 110" explicitly listed in the

specification was a stepper tool. However, it was
highly unlikely that a person of skill in the art
would not know that an "exposure tool 110" may
encompass other exposure tools such as a step-and-
scan tool (e.g., a deep ultraviolet exposure tool).
Such a position seemed unsupported and untenable.
Indeed, the board did not allude to any reason as to
why a person of skill in the art would not know of
other examples of an "exposure tool 110" and this
was not surprising as exposure tools were well known
in the art.

–   Similarly, the board's position that it remained
    unclear as to how the claimed method and apparatus
    might be implemented in "other manufacturing
    processes... (e.g. with a single stepper)" was
    incorrect. As is described in the specification, a
    semiconductor device might be processed in an
    exposure tool and then checked by a review station
    for errors. After error checking was performed, the
    semiconductor device might be again placed in an
    exposure tool for processing. The selection of a
    particular tool for the second processing step, as
    described immediately above, might vary between
    manufacturing processes. In other words, a
    semiconductor device might then be placed into
    another exposure tool or placed back into the same
    exposure tool for additional processing. Applicant
    submitted that a complete reading of the
    specification, as cited above, would make this clear
    to a person of skill in the art.

Reasons for the Decision

1.   The appeal is admissible.

2.   *Support by the description (Article 84 EPC 1973)*

2.1   Article 84 EPC 1973 requires *inter alia* that the claims
       shall be supported by the description. The requirement
       that the subject-matter of the claims be supported by
       the description implies that the claims should relate
       to what has been described and that it is not allowable
       to claim something which was not described. However, a
       purely formal support, ie a verbatim repetition in the
       description of the wording of the claims, does not meet
       this requirement.

2.2   The present application relates to a method for
       controlling a manufacturing process using a
       hierarchical system in which the parameters (called
       control input parameters) controlling the manufacturing
       process are stored. The description illustrates the
       invention on the basis of an overlay process employed
       during the manufacture of semiconductor devices.
       Overlay control involves measuring the misalignment
       between two successive patterned layers on the surface
       of a semiconductor device. The result from the analysis
       of the overlay errors is used to make updates to the
       control settings for a subsequent run of a lot of
       semiconductor wafers (page 3, lines 12 to 19; page 4,
       lines 1 to 6).

2.2.1 The updated control input signals can be implemented by
       control threads which identify a batch of lots with
       similar characteristics. For overlay control, the

control threads are separated by a combination of different conditions including the semiconductor manufacturing tool (eg stepper) currently processing the wafer lot, the semiconductor product, the semiconductor manufacturing operation and the semiconductor manufacturing tool that processed the semiconducting wafer lot at a previous layer of the wafer (page 5, lines 3 to 11). The present invention teaches a method of hierarchical ordering of the conditions, or attributes, that constitute a control thread. The hierarchical ordering of control thread data is related to the strength of the effects that these conditions exert on the control of the manufacturing process. One example of hierarchical ordering of control thread is as follows. The control inputs of the specific tool used at a process have a major influence on the control inputs of the present process. This can thus be defined as the first level of a hierarchical ordering of the control thread data. The control inputs of the manufacturing tool employed at a previous operation may be the second most influential factor on the control inputs of the present process. This can be defined as the second level of the hierarchical ordering of control thread data. The control inputs relating to a similar product type may be the third most influential factor on the control inputs of the present process and this can be defined as the third level of the hierarchical ordering of control thread data (page 7, lines 15 to 25). The different levels in the hierarchy are therefore arranged in order of the relative impact each of the previous process factors have on the variance of the present manufacturing process.

2.2.2   The application discloses the implementation of the
        controlling method as follows. The highest relevant
        hierarchical level that relates to the present process
        step is determined, ie the control thread that
        represents the hierarchical level closest to the top
        hierarchical level related to the present process step
        is found. When a hierarchical level that contains a
        control thread that can be utilized for the present
        process is not found, the default settings are used to
        determine the new input control settings for the
        present process step. This new input control setting is
        then filled into an appropriate bin in a hierarchical
        level. When a relevant hierarchical level that contains
        a control thread that can be utilized for the present
        process is found, the next lower hierarchical level is
        checked to determine if it contains a control thread
        that is more closely, or specifically, related to the
        present process. When a relevant control thread is
        found in a lower hierarchical level, the next lower
        hierarchical level is checked. This process is repeated
        until the lowest hierarchical level that contains a
        relevant control thread for the current process is
        found. When the lowest hierarchical level checked does
        not contain relevant control thread data, the control
        thread data from the previous hierarchical level is
        used to control the present process step, ie data from
        the lowest relevant hierarchical level, which contains
        the most specific control thread for the present
        process is used. This data is thus used to generate the
        new control settings for the present process step
        (page 8, lines 8 to 33; Figure 5).

2.3   The board finds that the claims of all claim requests
         are not supported by the description as required by
         Article 84 EPC 1973, for the following reasons:

2.3.1   Claim 1 of the main, 1st, 2nd and 4th auxiliary requests
         relate to *"A method for controlling a manufacturing
         process using a hierarchical system, comprising:
         processing a first lot of semiconductor devices …"*, ie
         the claim covers all processes involved in
         manufacturing a semiconductor device.

2.3.2   The description illustrates the claimed controlling
         method only on hand of an overlay process using an
         exposure tool, in particular a stepper machine. The
         board cannot see how the controlling method disclosed
         in the description can be applied to all the processes
         involved in semiconductor device manufacturing. In
         particular, as semiconductor device manufacture
         involves a large variety of extremely different and
         highly sophisticated processes, starting at the
         photolithographic exposure of the semiconductor wafer,
         including oxidation of the wafer, deposition and
         interconnection of subsequent layers and finally
         assembly and packaging of the device and testing the
         finished semiconductor device.

2.3.3   The skilled person, by reading the disclosure of the
         present application, is not put in a position allowing
         him to implement the claimed controlling method in
         substantially all semiconductor device manufacturing
         processes. This was implicitly acknowledged by the
         appellant applicant when he pointed out that the
         specification referred to "exposure tool[s] 110", ie
         that it also comprised other exposure tools such as a

step-and-scan tool, and was not limited to a stepper apparatus. However, the method of claim 1 of the main, 1st, 2nd and 4th auxiliary requests is not limited to a method for controlling an exposure tool, but relates to all methods relating to controlling a manufacturing process of a semiconductor device.

2.3.4   Furthermore, claim 1 of all claim requests specifies *inter alia* that:

(a)   a first lot of semiconductors is processed using a first set of control input parameters,

(b)   this first set of control input parameters is stored in one of the hierarchical levels of the control thread,

(c)   process data are acquired from the processing of the first lot of semiconductors (eg the analysis of the misalignment errors in an overlay process),

(d)   a second set of control input parameters is determined based upon the acquired process data,

(e)   the second set of control input parameters is also stored in one of the hierarchical levels of the control thread

(f)   the first and second sets of control parameters are implemented in a subsequent semiconductor device processing sequence for a third lot of semiconductor devices.

2.3.5   These steps are however inconsistent with what is
        disclosed in the description. According to the
        description, the overlay error, ie the misalignment
        between two successive patterned layers on the surface
        of a semiconductor device, is measured. The result from
        the analysis of the overlay errors is used to make
        updates to the control settings for a subsequent run of
        a lot of semiconductor wafers (page 3, lines 12 to 19;
        page 4, lines 1 to 6). It is not disclosed that the
        updated control settings are stored and that both the
        original and the updated control setting are employed
        for processing a further lot of semiconductor devices,
        as specified in steps (e) and (f) mentioned above.
        Updating implies the replacement of the previous
        control settings by new ones, whereby the previous
        control settings become unavailable and can no longer
        be employed for processing further lots. This, however,
        is not what is being claimed.

2.3.6   The board judges for these reasons that the method of
        claim 1 of all requests is not supported by the
        description.

Order

For these reasons it is decided that:

The appeal is dismissed.

Registrar   Chair

S. Sánchez Chiquero   G. Eliasson