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**Datasheet for the decision  
of 20 January 2020**

**Case Number:** T 0484/17 - 3.2.01

**Application Number:** 10171819.5

**Publication Number:** 2283960

**IPC:** B23K26/12, B23K26/16,  
B23K26/36, B23K26/06

**Language of the proceedings:** EN

**Title of invention:**  
Gas-assisted laser ablation

**Patent Proprietor:**  
FEI Company

**Opponent:**  
Carl Zeiss Microscopy GmbH

**Headword:**

**Relevant legal provisions:**  
EPC Art. 52(1), 56

**Keyword:**  
Inventive step - (yes)

**Decisions cited:**

G 0004/95

**Catchword:**



**Beschwerdekammern**  
**Boards of Appeal**  
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Case Number: T 0484/17 - 3.2.01

**D E C I S I O N**  
**of Technical Board of Appeal 3.2.01**  
**of 20 January 2020**

**Appellant:** Carl Zeiss Microscopy GmbH  
(Opponent) Carl-Zeiss-Promenade 10  
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**Representative:** Carl Zeiss AG - Patentabteilung  
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**Respondent:** FEI Company  
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**Representative:** Pollard, Peter Julian  
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**Decision under appeal:** **Decision of the Opposition Division of the  
European Patent Office posted on 21 December  
2016 rejecting the opposition filed against  
European patent No. 2283960 pursuant to Article  
101(2) EPC.**

**Composition of the Board:**

**Chairman** G. Pricolo  
**Members:** V. Vinci  
A. Jimenez

## **Summary of Facts and Submissions**

- I. The appeal was filed by the Appellant (Opponent) against the decision of the opposition division to reject the opposition filed under Article 100(a) EPC in combination with Articles 52(1), 54 and 56 EPC against the patent in suit.
- II. The opposition division decided that the subject-matter of the claims as granted is novel and involves an inventive step.
- III. Oral proceedings were held before the Board on 20 January 2020.

The Appellant requested that the decision under appeal be set aside and the patent be revoked in its entirety.

The Respondent (Patent Proprietor) requested that the appeal be dismissed.

- IV. Claim 1 of the patent as granted reads as follows:

A method of removing material from a sample by laser ablation while reducing redeposition, the method comprising:

providing an apparatus for laser micro-machining having a vacuum chamber for holding a sample, a source of a precursor gas, and a laser system for operating on the sample in the vacuum chamber, the laser system generating a pulsed laser beam having an energy great enough to ablate the sample;

loading a sample into the vacuum chamber; and

directing the laser at the sample to ablate the surface, the laser operated at a fluence greater than the ablation threshold of the sample material so that sample particles are ejected into the precursor gas atmosphere in the vacuum chamber;

the method characterized by:

filling the vacuum chamber with a precursor gas at a desired gas pressure to form an atmosphere of precursor gas particles in the vacuum chamber around the sample, the precursor gas being a gas that will react with the sample material, when sufficient energy is provided to initiate said reaction, to form a volatile compound that will not redeposit onto the sample surface;

the laser providing sufficient energy to the ejected sample particles to initiate the reaction with the precursor gas particles in the atmosphere of precursor gas particles in the vacuum chamber; and

the desired gas pressure providing an adequate concentration of gas particles in the vacuum chamber so that the majority of the ejected material is volatilized in the atmosphere of the vacuum chamber before redeposition.

In the following the labelling of the features of the granted claim 1 adopted in the decision under appeal will be adhered to.

V. In the present decision reference is made to the following documents which have been cited in the opposition proceedings:

D1: US 2006/249480 A1

D2: WO 2007/142610 A1  
D3: US 7 238 294 B2  
D4: US 2003/155328 A1  
D5: US 3 866 398 A

VI. The Appellant's arguments can be summarised as follows:

At the oral proceedings the Appellant withdrew the objection of lack of novelty over D1 and focused on the lack of inventive step. It was acknowledged that the features (d1) and (f) of claim 1, read in combination, were not disclosed in D1.

However, a person skilled in the art, aiming to improve the method of D1 and further reducing the amount of silicon debris which redeposit on the silicon sample, would combine D1 with the teaching of D5, which is cited in D1 and which explicitly addresses the same technical problem as the contested patent (see column 1, lines 13 to 23) thereby arriving without inventive step to the method of claim 1. This conclusion is based on the following observations:

The chamber shown in figure 4 of D5 is a vacuum chamber in the meaning of claim 1 which does not specify that the chamber must be closed to the environment. By controlling the flow of precursor gas and thus its concentration in the area of impingement of the laser beam the reaction between the gas particles and the silicon debris is enhanced thereby preventing or reducing the deposition of unbounded silicon debris on the silicon sample (see column 2, line 67 onwards). The person skilled in the art knows from the gas law that the concentration of the particles of a gas at a constant volume and temperature is directly

proportional to the pressure of the gas. It follows that the teaching defined by the features (d1) and (e) of claim 1 is implicitly disclosed in D5. The fact that in the arrangement of figure 4 of D5 the silicon probe is not loaded into the vacuum chamber (feature (b) of claim 1) is irrelevant because this circumstance only depends on the large dimensions of the particular workpiece shown in figure 4 of D5.

The claimed subject-matter is also rendered obvious by the combination of D1 with D2. The Appellant refers to the passage of D2 on page 10, lines 11 - 16 disclosing the possibility of enhancing the reaction between the silicon particles and the precursor gas by increasing the concentration of gas, and to the passage of D2 on page 11, lines 18 to 22 teaching that a convenient pressure of gas must be established in the vacuum chamber. He thus concludes that as these teachings correspond to the features (d1) and (f) the person skilled in the art aiming to solve the technical problem underlying the patent would arrive to the subject-matter of claim 1 by an obvious combination of D1 with D2.

A further line of attack of is based on D4 in view of the general knowledge of the person skilled in the art. All the features of claim 1 with the exception of the use of a vacuum chamber are disclosed in D4 (see embodiment in figure 4). Contrary to the view of the opposition division this document would not teach away the person skilled in the art from adding a vacuum chamber in the embodiment of figure 4 if a controlled environment is required. This view is supported by paragraph [0057] of D4 suggesting the possibility to use of a chamber in which the silicon sample is placed.

Finally, starting from D4 the person skilled in the art would consider using a vacuum chamber in the apparatus and in the corresponding method of figure 4 as obviously suggested by any of documents D2, D3 or D5 which show laser ablation methods carried out in a vacuum chamber.

VII. The Respondent's arguments can be summarised as follows:

The person skilled in the art would not consider the teaching of D5 because the chamber of the apparatus in figure 4 is not a closed vacuum chamber in the meaning of claim 1. The method of D5 uses a chamber open at its lower end and is thus essentially carried out in an open environment. This operating condition does not allow for a control of the pressure. The principle of the gas law invoked by the Appellant does not apply to the open system of D5 because volume and temperature are not constant. The concentration of precursor gas in the area of the silicon sample is determined by controlling a difference of pressure in a limited lower part of the chamber rather than by establishing a desired, static pressure of precursor gas in a closed vacuum chamber as stated in claim 1. Moreover D5 does not disclose the feature (b) of claim 1. In view of the very different operation conditions, namely the closed environment of D1 vs. the open environment of D5, a person skilled in the art would be prevented from combining D1 with D5. In any case the teaching that the reduction of silicon debris which redeposit on the silicon sample can be maximized by establishing and controlling the pressure of the precursor gas in a closed vacuum chamber is not disclosed in these documents even if taken in combination.



Insofar the combination of D1 with D2 is concerned the Respondent argues that no correlation between the pressure to be applied in the vacuum chamber and the reduction of the debris which redeposit on the sample can be implied by the passages cited by the Appellant. On the contrary D2, page 11, lines 18 to 22, suggests an upper limit for the pressure in the vacuum chamber ("pressure typically below 1 PA") which would teach away from the basic principle of the contested patent, namely that an increase of the pressure results in an enhanced reaction between the precursor gas and the silicon debris and thus in a reduction of the amount of unbounded silicon debris redepositing on the silicon sample.

Having regard to the combination of D4 with the general knowledge of the person skilled in the art or with D2, D3 or D5 the Respondent puts forward that D4 teaches away from the use of a vacuum chamber in the apparatus of figure 4 of D4. In any case no hint can be found to the idea of using the pressure of the precursor gas as the relevant operational parameter for minimizing redeposition of the unbounded material ejected from the sample during the laser ablation process.

## **Reasons for the Decision**

### **PROCEDURAL ISSUES**

1. After having been notified of the summons to attend oral proceedings and after having received the communication of the Board pursuant to Article 15(1)

RPBA (version in force until 31 December 2019) both parties requested the Board in writing to grant their respective accompanying persons the opportunity to make oral submissions during the oral proceedings in view of their expertise in the present technical field.

- 1.1 The Board notes that in their requests the parties did not specify the particular technical issues to be addressed by the respective accompanying persons. It follows that the requests at stake have not been properly substantiated. Furthermore, taking into account that all technical issues at stake had been clearly identified in the course of the written proceedings, it was to be expected that the representatives of the parties be able to present the case at the oral proceedings without relying on further oral submissions to be made by the accompanying persons.
- 1.2 Under these circumstances and according to established case law of the Boards of Appeal (see G4/95), the Board did not consider it appropriate to make use of its discretion to allow oral submissions made by the accompanying persons at the oral proceedings.
- 1.3 For completeness and as clarified by the Board at the beginning of the oral proceedings the rejection of the requests at stake did not exclude that the representatives of the parties might consult the respective accompanying persons if appropriate.

**INVENTIVE STEP**

2. The Board agrees with the view expressed by the opposition division in the decision under appeal that the technical problem underlying the invention

according to claim 1 of the contested patent, starting either from D1 or D4, is to improve the laser ablation method in order to minimize the amount of unbounded silicon debris redepositing on the silicon sample during the laser ablation process. This was not disputed by the parties.

D1 in view of D5

3. The Appellant acknowledges that the subject-matter of claim 1 differs from the content of D1 in the features (d1) and (f) which must be read in combination as correctly stated by the opposition division. The line of attack of the Appellant based on a combination of D1 with D5 is not convincing for the following reasons:

The Board concurs with the view of the Appellant and of the opposition division that D5 addresses the same technical problem as the contested patent. However, the Board agrees with the opposition division that the method of D5 (see operation of the apparatus in figure 4) does not use a vacuum chamber in the meaning of D1 and of claim 1, but rather an open chamber. The chamber of D5 is in fact fully open to the environment at its bottom. A precursor gas is introduced only into the bottom part of the chamber and the gas concentration is locally regulated by applying a difference of pressure between the vacuum ports 11 and the gas inlets 13 on both side of the silicon sample which is positioned fully outside the chamber. The chamber of D5 is thus not filled with a precursor gas (the flux of gas is provided only at the lower part of the chamber and it does not fill the whole chamber) to form an atmosphere of precursor gas particles in the vacuum chamber around the sample (the flux of the precursor gas introduced in the chamber of D5 only contacts the upper surface of

the silicon sample).

D1 proposes instead to fully locate the silicon sample within a chamber fully closed to the environment and filled by a precursor gas establishing a certain pressure in the chamber and forming an atmosphere of gas around the sample.

- 3.1 Under these circumstances the Board follows the reasoning of the opposition division that the person skilled in the art, in view of the constructional and operational differences listed above, would be discouraged from applying the teaching of D5 in the method of D1 in order to solve the technical problem underlying the contested patent.
- 3.2 In any case the Board further concurs with the opposition division that D5 fails to disclose the teaching of the patent as it results from the features (d1) and (f) read in combination, namely the idea that it is possible to minimize the amount of unbounded debris redepositing on the sample during the laser ablation process by using the value of the pressure established within the vacuum chamber as an operational parameter to efficiently control the process.
- 3.3 In this respect the argument of the Appellant that the gas law would directly imply that controlling/increasing the concentration of the particles of the precursor gas as suggested in D5 corresponds to control/increase the pressure in the vacuum chamber as suggested in claim 1 is not convincing for the following reasons:

The alleged implication of the gas law is correct only when operating at constant temperature and volume. This

is not the case when using the apparatus of figure 4 of D5 because owing to the use of a fully open chamber the volume is not constant and because there is no indication in D5 that the apparatus of figure 4 is operated by keeping the temperature constant.

- 3.4 The Board thus supports the conclusion of the opposition division that the person skilled in the art would not obviously combine D1 with D5 and that in any case, such a non obvious combination would not lead to the subject-matter of claim 1.

D1 in view of D2

- 3.5 The Boards concurs with the observation of the opposition division that although in the method of D2 the precursor gas is primarily provided in order to enhance the laser ablation process this document also discloses as an additional effect that reduction of re-deposition of the material ejected from the sample surface is thereby achieved (see page 10, line 11 onwards).
- 3.6 However, as correctly noted by the opposition division, there is no hint in D2 suggesting that this additional effect is achieved by controlling the pressure in order to enhance the reaction between the particles of precursor gas and the material ejected from the sample surface during laser ablation. The counter-argument of the Appellant that claim 1 is silent about this reaction is void because the feature (e) of claim 1 states indeed that such a reaction takes place and leads, in combination with an adequate choice of the pressure in the vacuum chamber (feature (d1)), to the result according to feature (f). The further argument of the Appellant that D2, page 11, lines 18-22, teaches

to enhance the reaction of the particles of precursor gas with the silicon debris according to features (d1) and (f) of claim 1 is not convincing because the step of establishing a "convenient pressure" in the vacuum chamber is not disclosed in relation to the aim of increasing the concentration of gas particles around the silicon sample presented on page 10 of D2.

- 3.7 In conclusion there is no teaching in D2 that an appropriate selection of the pressure in the vacuum chamber can influence and enhance the binding reaction between the precursor gas particles and the silicon debris so as to volatilize the majority of the ejected material.

D4 in view of the general technical knowledges

- 3.8 Regardless of whether the person skilled in the art in view of paragraph [0057] of D4 would be discouraged from using a vacuum chamber in the apparatus and method according to Fig. 4 of D4 or rather encouraged, the features (d1) and (f) read in combination are neither disclosed in D4, as correctly argued by the opposition division (point 3.3.2, a and b, of the contested decision) nor can be considered to be obvious in the light of the general technical knowledge of the person skilled in the art. The allegation of the Appellant that it would be obvious for a person skilled in the art to consider the pressure in the vacuum chamber as a suitable operational parameter for minimizing the re-deposition of the material ejected from the sample remains unsubstantiated.

D4 in view of D2, D3 or D4

- 3.9 This further and last line of attack of the Appellant is based on the assumption that the subject-matter of claim 1 would only differ from D4 in that a vacuum chamber is used. This measure is however generally known from D2, D3 and D5 which also relate to laser ablation processes and might be applied to the method of D4 without involving an inventive step. This argument is not convincing for the same reasons presented with respect to the previous attack, namely that there is no obvious hint in D4, D2 D3 and D5 leading to the teaching expressed by the features (d1) and (f) of claim 1 of the contested patent read in combination.
4. For these reasons the Board does not see any reason for deviating from the conclusions of the opposition division in the decision under appeal that the subject-matter of claim 1 of the contested patent involves an inventive step over the prior art pursuant to Articles 52(1) and 56 EPC.

**Order**

**For these reasons it is decided that:**

The appeal is dismissed.

The Registrar:

The Chairman:



A. Vottner

G. Pricolo

Decision electronically authenticated