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Datasheet for the decision of 12 December 2024

Case Number: T 2219/21 - 3.4.03

Application Number: 11748227.3

Publication Number: 2539915

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Language of the proceedings: EN

Title of invention:
PLASMA MASS SPECTROMETRY WITH ION SUPPRESSION

Applicant:
PerkinElmer Health Sciences, Inc.

Headword:
Reaction/Collision Cell

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - (no) - main request (no) - auxiliary requests (no) - common general knowledge - obvious solution

Decisions cited:

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Beschwerdekammern

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Case Number: T 2219/21 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 12 December 2024

Appellant: (Applicant)	PerkinElmer Health Sciences, Inc. 940 Winter Street Waltham, MA 02451 (US)
Representative:	Marks & Clerk LLP 15 Fetter Lane London EC4A 1BW (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 7 July 2021 refusing European patent application No. 11748227.3 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chair	M. Papastefanou
Members:	M. Stenger
	T. Bokor

Summary of Facts and Submissions

I. The appeal is against the decision of the examining division to refuse European application No. 11 748 227.

II. The appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the main request or one of the first or second auxiliary requests currently on file.
These requests are the main request and the auxiliary requests 1 and 2 filed on 30 April 2021 underlying the contested decision.

III. With a letter dated 28 November 2024, the appellant announced that it would not be attending the oral proceedings before the board scheduled for 12 December 2024. The oral proceedings were cancelled.

Reference is made to the following document:

D4: S TANNER: "Reaction cells and collision cells for ICP-MS: a tutorial review", SPECTROCHIMICA ACTA PART B: ATOMIC SPECTROSCOPY, vol. 57, no. 9, 13 September 2002 (2002-09-13), pages 1361-1452, XP055003386, ISSN: 0584-8547, DOI: 10.1016/S0584-8547(02)00069-1

IV. Claim 1 of the main request reads as follows (labelling **A**, **B**, ... added by the board):

A *A system configured to permit switching of a cell between at least two modes comprising a collision mode and a reaction mode, the system comprising:*
B *a cell configured to receive a collision gas in a collision mode to pressurize the cell and configured to*

receive a reactive gas in a reaction mode to pressurize the cell,

B1 *the cell comprising a quadrupole rod set,*

B2 *the cell further comprising a gas inlet;*

B3 *a voltage source;*

B4 *a gas source in fluid communication with the gas inlet of the pressurized cell;*

B5 *a pump fluidly coupled to the pressurized cell; and*

B6 *a controller electrically coupled to the voltage source and the pump,*

C *wherein the voltage source is coupled to the quadrupole rod set of the pressurized cell and is configured to provide a voltage from the voltage source to the quadrupole rod set to provide a quadrupolar field within the cell,*

D *the controller configured to provide a first effective voltage from the voltage source to the quadrupole rod set of the cell in the collision mode to select ions comprising an energy greater than a selected barrier energy,*

E *wherein the controller is configured to enable a source of gas from the gas source to fill the cell with a quantity of an inert gas up to a predetermined pressure to pressurize the cell when the system is in the collision mode,*

F *the controller further configured to provide a second effective voltage from the voltage source to the quadrupole rod set of the cell in the reaction mode to select ions using mass filtering,*

G *and wherein the controller is configured to instruct the pump to evacuate the inert gas from the pressurized cell when the system switches from the collision mode to the reaction mode*

H *to enable the gas source to provide a selected reactive gas to the evacuated cell at a predetermined*

pressure to pressurize the cell when the system is in the reaction mode.

V. Claim 1 of the first auxiliary request differs from claim 1 of the main request in that feature **B** is replaced by feature **B'** and in that it comprises additional feature **I** between features **A** and **B'** and additional feature **J** at its end, as follows (labelling **A**, **B'**, ... and underlining of additional features w.r.t. claim 1 of the main request by the board):

I *an ion source (12) configured to generate a plurality of ions;*
B' *a cell (36) fluidly coupled to the ion source (12) to receive the plurality of ions from the ion source, the cell (36) further configured to receive a collision gas in a collision mode to pressurize the cell (36) and configured to receive a reactive gas in a reaction mode to pressurize the cell (36),*
J *and an exit barrier at an exit end of the pressurized cell (36), the exit barrier permitting ions with at least a certain minimum kinetic energy to penetrate the exit barrier while trapping slower ions not having sufficient kinetic energy within the pressurized cell (36).*

VI. Claim 1 of the second auxiliary request differs from claim 1 of the main request in that features **A** and **B** are replaced by features **A'** and **B''** and in that it comprises additional feature **I** between features **A'** and **B''** and additional feature **K** between features **F** and **G** as follows (labelling **A'**, **B''**, ... and underlining of additional features w.r.t. claim 1 of the main request by the board, feature deleted from claim 1 of the main request shown in strike through by the board):

A' *A mass spectrometer system (10) configured to permit switching of a cell (36) between at least ~~two~~ three modes comprising a collision mode, a standard mode, and a reaction mode, the system comprising:*
I *an ion source (12) configured to generate a plurality of ions;*
B'' *a cell (36) fluidly coupled to the ion source (12) and configured to receive a collision gas in a collision mode to pressurize the cell (36), and configured to receive a reactive gas in a reaction mode to pressurize the cell (36), and configured to be maintained under vacuum in the standard mode,*
K *wherein the controller (60) is configured to maintain the cell (36) under vacuum in the standard mode,*

VII. In the contested decision, the examining division set out that the subject-matter of the independent system claims of the then main request and the then auxiliary requests 1 and 2 lacked an inventive step within the meaning of Article 56 EPC in view of D4 combined with the skilled person's customary practice and skills. The examining division further did not admit the then auxiliary request 3 filed during the oral proceedings.

VIII. The appellant essentially submitted that the examining division read too much into D4, in particular with respect to section 8.4.1. D4 disclosed only a single pressurized mode having the characteristics of both the two distinct modes claimed. D4 may disclose that it can be operated in two modes, but not that the device is able to switch between the two modes as claimed.

Reasons for the Decision

1. The appeal is admissible

2. The application

The application relates to a pressurized cell for use in mass spectrometry. In mass spectrometry, ions of interest ("analyte ions") can coexist in the ion stream together with other unwanted ion populations ("interferer ions") that have substantially the same nominal m/z ratio. The pressurized cell has two modes of operation, a "collision mode" and a "reaction mode". In each of these modes of operation, the interferer ions are selectively eliminated. The cell can be switched from one mode of operation to the other.

3. The relevant prior art

Document D4 is a tutorial review relating to reaction/ collision cells for mass spectrometry. The document discusses in detail a number of aspects of operating such cells, in particular operation of pressurized cells with the aim of suppressing unwanted ions.

4. Main request, claim 1

4.1 The appellant did not dispute that D4 discloses the main structural elements of the claimed cell, namely, a cell configured to receive gas, (part of feature **B**), a quadrupole rod set (feature **B1**), a gas inlet (feature **B2**), a voltage source (feature **B3**), a gas source (feature **B4**), a pump (feature **B5**) and a controller electrically coupled to the voltage source (part of feature **B6**).
The appellant did not dispute, either, that D4 discloses that the controller and the voltage source of D4 are configured according to features **C** and **F** and

that the gas source is enabled to provide a selected reactive gas to the cell according to feature **H**.

4.2 The **examining division** (section II.1.2 of the contested decision) held that the subject-matter of claim 1 of the main request differed from the device disclosed in D4 only in that the controller was
- coupled to the pump (part of feature **B6**) and
- configured to instruct the pump to evacuate the inert gas from the pressurized cell when the system switches from the collision mode to the reaction mode (feature **G**).

These distinguishing features had the technical effect of removing the inert gas from the cell before the reactive gas was injected. The problem to be solved could be regarded as providing an improved collision cell which could operate in both the collision mode and the reactive mode.
The examining division concluded that the subject-matter of claim 1 of the main request was not inventive in view of D4 combined with the skilled person's customary practice and skills (contested decision, sections II.1.3 to II.1.12)

4.3 The **appellant** submitted that the examining division's reasoning relied "too heavily" on allegedly "implicit" features disclosed in D4, was too "far reaching" and was "inconsistent" with the post-cell kinetic energy discrimination in section 8.4.1 of D4.

4.3.1 More particularly, D4 stated that the ELAN DRC had two principal modes of operation, a standard mode with a vented cell and a DRC mode in which the cell contained reactive or non-reactive gas. This DRC mode, however, was a single pressurized mode of operation.

4.3.2 Within the DRC mode, D4 as a tutorial review discussed the general principles of both collision and reaction modes. For instance, on page 1373 (right column), a mode akin to the reaction mode of the application was disclosed. D4 then continued to mention that kinetic energy discrimination could "also be employed". However, D4 noted that the terms for these modes were not consistently distinguished, and D4 did not draw a clear distinction between these modes. Instead, D4 taught that in DRC operation, both modes were often used in combination, as disclosed on page 1406 w.r.t. the example where the cell was pressurized with 20 mTorr of ammonia. Generally, section 8.4.1 discussed the provision of an energy barrier only in the context of operating in a mixed collision/reaction mode.

4.3.3 The use of a non-reactive gas in the DRC mode of D4 did not equate to the collision mode as claimed, because even with such a gas, novel ions were created by chemical reactions (section 8.3 on page 1412, second sentence). The novel ions permitted filtering by m/z ratio, but not by barrier energy as in the collision mode of the claims.

There was no evidence that such novel ions would also be created in the collision mode of the application. Instead, according to claim 1 of the main request, the controller instructed the pump to evacuate inert gas prior to introducing reactive gas. This would be expected to reduce the risks of any contaminants. D4 was silent about any configuration of controllers and inert gas sources. Thus, the skilled person would not have considered the operation of the cell in this manner, including such an evacuation.

4.3.4 Section 8.4.1 of D4 only disclosed an energy barrier outside and downstream of the cell. It did not disclose altering ion energy based on introduction of an inert collision gas.

4.3.5 At best, D4 taught an operation of a Perkin Elmer SCIEX ELAN DRC with a reactive gas in a pressurized cell followed by such an energy barrier to eliminate certain reactant products, and then a mass analyzer to distinguish between remaining reactant products and plasma ions. Thus, D4 possibly disclosed energy discrimination of reaction products downstream of the DRC as described in section 8.4.1 in addition to operation of the DRC in the reaction mode, but not that kinetic energy discrimination ('KED') could be performed in the cell, without any reaction mode. Therefore, D4 did not disclose any separate collision mode or energy discrimination by the DRC.

4.3.6 "Switching" of the operation mode of the D4 device could theoretically be possible, for instance by disassembling and reconstructing various components of the device. However, D4 did not disclose switching between collision and reaction modes in the manner recited in the claims, since D4 did not clearly distinguish between these modes. Starting from D4, the skilled person would simply not have perceived the need to separate such modes.

There was nothing in D4 that taught that switching as claimed would be desirable or possible. No practical issues arising during such switching were considered in D4, either, in contrast to the application as explained in paragraphs [55] to [57] and [61] to [63].

4.3.7 The board notes that the appellant thus essentially submitted that D4 did not disclose or suggest a pure collision mode and therefore also none of the aspects relating to switching the cell from collision mode to reaction mode. These submissions concern features **A**, **B**(part), **B6**(part), **D**, **E** and **G**

4.4 The **board's** finding

4.4.1 The board takes note of the appellant's submission (see section 4.3.1 above) that D4 explicitly mentions two modes of operation, a standard mode and a DRC mode (D4, page 1364, left column, last paragraph).
However, the appellant's interpretation of the DRC mode as a single pressurized mode of operation (see section 4.3.1 above) overlooks that for a pressurized operation, many parameters have to be established, for instance the composition and the pressure of the gas in the cell as well as the voltage applied, for instance to the rods of the (quadru)pole. That is, the DRC mode of D4 already represents in itself a multitude of possibilities (or modes) of operating the cell.

4.4.2 According to claim 1, an inert gas and a voltage establishing a barrier energy are chosen in collision mode (features **D** and **E**). In reaction mode, a selected reactive gas and a voltage enabling mass filtering are chosen (features **F** and **H**).
Hence, the differences between the collision mode and the reaction mode claimed do not go beyond differences in the parameters that have to be chosen anyway according to D4 in the DRC mode when the cell is pressurized.

4.4.3 With respect to the Perkin Elmer SCIEX ELAN DRC, D4 explicitly discloses two different sets of parameters

that may be used during pressurized operation of the cell (page 1373, right column, penultimate paragraph; see also lower left part of Figure 4).

The first set consists of relatively heavy reaction gases, pressures at near-thermal conditions (that is, pressures which favour chemical reactions) and voltages applied to the quadrupole that establish a mass bandpass. This first set of parameters corresponds to what is defined in claim 1 for the reaction mode, as also acknowledged by the appellant (see section 4.3.2 above).

The second set of parameters consists of low mass collision gases, (relatively low) pressures such that non-thermal conditions are achieved (that is, pressures which do not favour chemical reactions) and voltages that establish a barrier energy (kinetic energy discrimination). The board holds that this second set of parameters corresponds to what is defined in claim 1 for the collision mode.

4.4.4 The board takes note of the argument of the appellant (see section 4.3.2 above, referring *inter alia* to the pressurization of the cell with ammonia at 20 mTorr where non-thermal collisions occur as described on page 1406, left column of D4), that the cells disclosed in D4 may be operated with parameters which might be considered to have a combination of characteristics of both claimed modes.
With respect to the example referred to by the appellant, the board notes, however, that the non-thermal collisions mentioned occur before and not within the cell ("during its transit between the skimmer and the cell").

In any case, that the cells disclosed in D4 may possibly be operated in a combination of collision and reaction modes does not alter the fact that D4 teaches two distinct parameter sets corresponding to the reaction mode and the collision mode as claimed in a general manner, respectively, see section 4.4.3 above.

The board notes that these two distinct parameter sets at least partly exclude each other. That is, it is not possible to operate a cell with relatively heavy reaction gases at pressures that provide near-thermal conditions as required by the first set of parameters and, at the same time and in combination, with low mass collision gases under non-thermal conditions as required by the second set of parameters.

4.4.5 Moreover, the board does not believe that the expression "Kinetic energy discrimination can also be employed..." in the right column on page 1373 (underlining by the board) referred to by the appellant (section 4.3.2 above) would be interpreted by the skilled person as meaning that kinetic energy discrimination ('KED') can be used only in addition to the mode "akin to the reaction mode" of the application.
Instead, the board is convinced that the skilled person would interpret this expression such that KED can be used in lieu of the mode "akin to the reaction mode" described in D4 just above KED.

D4 may indeed observe that the terms "reaction mode" and "collision mode" are not consistently distinguished, as submitted by the appellant (see section 4.3.2 above). Nevertheless, D4 discloses distinct parameter sets for each of these modes and thus, in practical terms, distinguishes between a

"collision mode" and a "reaction mode" as claimed, contrary to the submission of the appellant (see section 4.3.5 above). Hence, D4 does disclose a distinct, and separate, collision mode as claimed, contrary to the submission of the appellant.

In other words, the Perkin Elmer SCIEX ELAN DRC referred to in D4 may not be provided with a simple switch (in the sense of of a single button or similar) for changing from (in the terminology of the application) a "collision mode" to a "reaction mode", as submitted by the appellant (see section 4.3.6 above). Nevertheless, users of this device can operate it in each of these modes by choosing the appropriate parameters. The board is convinced that choosing such parameters would not involve disassembling and reconstructing components of the pressurized cell, contrary to the submission of the appellant (see section 4.3.4 above).

4.4.6 D4 discloses that even when a non-reactive gas is used in the cell, reactive contaminants are present, e.g. from entrainment of plasma gas. This may lead to reactions taking place resulting in the formation of new ions (see page 1412, third sentence of section 8.3), as pointed out by the appellant (see section 4.3.3 above).

However, reactive contaminants from entrainment of plasma gas are present in the cell of the application as well ("interferer ions", see paragraph [41] of the published application). The board notes that evacuation of the inert gas prior to introducing reaction gas does not reduce the risk of contaminants being present, since these contaminants are created by the plasma, i.e. during operation. The board further notes that the

examples for interferer ions given in the application (argide ions) correspond to the contaminants discussed in section 8.3 of D4.

Thus, even if a non-reactive gas is intentionally used as mentioned in D4, the presence of contaminants does not give any reason to assume that the second set of parameters including the use of an inert gas does not correspond to the "collision mode" of the application, contrary to the appellant's submission.

In addition, D4 discloses in section 8.4. a passive operation of the cell, in which "the chemistry is allowed to proceed unhindered". That is, the cell does not contain a reaction gas in this case, which again implies the exclusive use of an inert gas in the cell and thus corresponds to the collision mode as claimed.

4.4.7 According to section 8.4.1 of D4, the potential barrier may be placed "downstream of the cell".
However, this may be done by means of an aperture lens or by a positive bias voltage of the mass analyzer with respect to the cell pole bias potential (page 1415, left column, second paragraph). On page 1415, right column ("the energy discrimination device is applied at ... the exit of the cell") and page 1416 (starting from the second paragraph of the left column), similar arrangements for the application of the kinetic energy barrier are disclosed.
This corresponds to what is done according to the application, see paragraphs [0060] and [0061].

Thus, the wording "downstream of the cell" used in D4 does not necessarily mean that the energy barrier is arranged outside of the cell, contrary to the submission of the appellant (see section 4.3.4 above).

Instead, this wording comprises arrangements corresponding to the arrangements of the application.

In addition, section 8.4.1 of D4 mentions "energy damping" (page 1415, left column, third paragraph). Furthermore, the board notes that D4 explicitly mentions that the usual outcome of non-reactive (and therefore inert) collisions between an ion and a neutral (which is thus part of an inert gas) is energy exchange (page 1384, right column, between formulas 6.28 and 6.29).

Therefore, D4 discloses altering ion energy based on introduction of an inert collision gas, contrary to the submission of the appellant (see section 4.3.5 above).

4.4.8 Distinguishing features

As set out above, the Perkin Elmer SCIEX ELAN DRC can be operated, within its DRC mode, such that its operation corresponds either to the "collision mode" or to the "reaction mode" of the application. The board concurs with the examining division that changing, or in the wording of the claim, "switching", the device from one manner of operation to the other must be possible by setting the parameters (e.g. composition and pressure of the gas content of the cell, voltages) accordingly.
Hence, contrary to the submissions of the appellant, D4 discloses most of the aspects relating to a pure collision mode and to switching of the cell from such a collision mode to reaction mode, in particular the ones comprised in features **A**, **B**, **D** and **E**. Thus, D4 discloses these features in their entirety.

In addition and also as mentioned above (see section 4.4.4), the gas composition in the cell differs between these two modes. Thus, in order to change from the collision mode to the reaction mode, the inert gas has to be replaced by the (relatively heavy) reaction gas. This implies that the inert gas is evacuated. Thus, D4 also discloses a part of feature **G**.

However, D4 does not disclose how the "switching" is performed. For example, D4 does not disclose how the parameters required for the different modes of operation are selected and controlled.
In particular, while it is implicit that in D4 the voltage is controlled by a controller, it is not implicit that the same controller also controls the composition and pressure of the gas in the cell. For controlling the flow of gas into the cell, D4 even explicitly mentions a separate controller ("Model 1478, MKS, Andover, MA", see page 1364, left column, last paragraph), while being silent concerning control of the pump.

D4 therefore does not disclose directly and unambiguously that the same controller that controls the voltage is coupled to the pump (part of feature **B6**) and configured to instruct the pump to evacuate the inert gas from the cell when switching from one mode of operation to the other (part of feature **G**), such that the gas content of the cell corresponds to the respective mode of operation.
The board notes that this finding corresponds essentially to the distinguishing features identified by the examining division.

4.4.9 Technical effect / objective technical problem

The technical effect of the distinguishing features set out above is that in the claimed system, switching from one mode of operation to another is made simpler, as compared with the system of D4.
The objective technical problem starting from D4 may then be formulated as providing an improved collision cell allowing to work in both the collision mode and the reactive mode, as set out by the examining division.

4.4.10 Inventive step - obviousness

The skilled person, when trying to solve this objective technical problem, would naturally configure the computer used to control the Perkin Elmer SCIEX ELAN DRC such that of all the parameters required for operation of the device, as many as possible will be controlled through the controlling computer, normally permitting the use of a single user interface. To do so does not require any skills going beyond the common general knowledge of the skilled person. The board notes that none of the practical issues referred to by the appellant (see section 4.3.6 above) is mentioned in the claims.

It follows from the above that it is obvious to use a single controller for controlling the voltage and the pump. This controller would then have to instruct the pump - possibly through an intermediate dedicated pump controller - to evacuate the inert gas when changing operation from collision mode to reaction mode as set out above (see section 4.4.8, second paragraph).
Thus, the subject-matter of claim 1 of the main request does not involve an inventive step within the meaning of Article 56 EPC in view of D4 combined with the

common general knowledge of the skilled person, as also concluded by the examining division.

5. Auxiliary request 1

In view of Figure 4, D4 discloses features **I** and **B'**. This was not disputed by the appellant.

However, the appellant submitted that D4 did not disclose an exit barrier at the end of a pressurized cell as defined in feature **J**. As set out in section 4.4.7 above, the board disagrees with this submission.

Hence, D4 discloses all additional and amended features of claim 1 of auxiliary request 1.

Thus, the subject-matter of independent claim 1 of auxiliary request 1 does not involve an inventive step within the meaning of Article 56 EPC in view of D4 and the common general knowledge of the skilled person.

6. Auxiliary request 2

Concerning auxiliary request 2, the appellant submitted that D4 did not disclose a quadrupole rod cell that could switch between a reaction mode, an energy discrimination mode and a vacuum (or standard) mode.

However, as set out above (see sections 4.4.1 to 4.4.3 above, the board holds that D4 discloses distinct reaction and collision modes. In addition, the standard mode mentioned in D4 in which the cell is vented (page 1364) corresponds to the vacuum mode referred to by the appellant. Thus, contrary to the submissions of the appellant, D4 discloses the three distinct modes defined in claim 1 of auxiliary request 2.

Hence, all additional and amended features of independent claim 1 of auxiliary request 2 are disclosed in D4 as well, as set out by the examining division.

Thus, the subject-matter of independent claim 1 of auxiliary request 2 also does not involve an inventive step within the meaning of Article 56 EPC in view of D4 and the common general knowledge of the skilled person.

7. Conclusion

The independent claims of all requests do not satisfy the requirements of the Convention. Hence, the appeal must fail.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chair:

S. Sánchez Chiquero M. Papastefanou

Decision electronically authenticated