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Case Number: T 2083/10 - 3.4.03

Application Number: 08013129.5

Publication Number: 1978570

IPC: H01L51/00, C23C14/04, C23C14/12

Language of the proceedings: EN

Title of invention:
INCREASING THE LATERAL RESOLUTION OF ORGANIC VAPOR JET DEPOSITION BY USING A CONFINING GUARD FLOW

Applicant:
The Trustees of Princeton University

Headword:

Relevant legal provisions:
EPC 1973 Art. 56, 76(1)

Keyword:
Divisional application - subject-matter extends beyond content of earlier application (no)
Inventive step - (yes)

Decisions cited:

Catchword:

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Case Number: T 2083/10 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 31 May 2017

Appellant: (Applicant)	The Trustees of Princeton University P.O. Box 36 Princeton, NJ 08544-0636 (US)
Representative:	Maiwald Patentanwalts GmbH Engineering Elisenhof Elisenstrasse 3 80335 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 16 August 2010 refusing European patent application No. 08013129.5 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	G. Eliasson
Members:	T. M. Häusser
	T. Bokor

Summary of Facts and Submissions

I. The appeal concerns the decision of the examining division refusing the European patent application No. 08 013 129 for added subject-matter (Article 76(1) EPC 1973) in relation to the former main request and for lack of inventive step (Article 56 EPC 1973) in relation to the former main request and the former auxiliary request.

II. Reference is made to the following documents:

D1: WO 03/020999 A,
D2: WO 02/087787 A.

III. In writing the appellant (applicant) requested the setting aside of the decision under appeal and the grant of a patent in the following version:
- Claims 1 to 15 as filed with the letter dated 18 August 2016;
- Description: pages 3, 3a to 3c, 5 to 8, 12, 15, and 17 as filed with letter dated 20 April 2017, page 18 as filed with letter dated 18 August 2016, and pages 1, 2, 4, 9 to 11, 13, 14, and 16 as originally filed;
- Drawings: sheets 1/15 to 15/15 as originally filed.

IV. The wording of independent claims 1 and 8 as well as dependent claim 4 is as follows (board's labelling "(i)"):

"1. A method of depositing an organic material, comprising:

ejecting a carrier gas carrying an organic material from the nozzle at a flow velocity that is at least 10%

of the thermal velocity of the carrier gas, such that the organic material is deposited onto a substrate;
(i) providing a guard flow around the carrier gas."

"4. The method of claim 1, wherein a dynamic pressure in a region between the nozzle and the substrate surrounding the carrier gas is at least 1333 Pa (10 Torr), and the background atmosphere is ambient atmosphere at about 101,325 Pa (about 760 Torr)."

"8. A device, comprising:
a nozzle, further comprising:
a nozzle tube having a first exhaust aperture and a first gas inlet; and
a jacket surrounding the nozzle tube, the jacket having a second exhaust aperture and a second gas inlet;
wherein the second exhaust aperture completely surrounds the first exhaust aperture;
a carrier gas source and an organic source vessel connected to the first gas inlet; and
a guard flow gas source connected to the second gas inlet;
wherein the device is configured for ejecting a carrier gas carrying an organic material from the nozzle at a flow velocity that is at least 10% of the thermal velocity of the carrier gas."

V. The appellant argued essentially as follows:

(a) Amendments

The elements of claim 4 were recited in original claims 1, 2, 4, 5 and 11 as well as in paragraph 8 of the parent application as filed.

(b) Inventive step

There was neither a motivation for combining documents D1 and D2, nor did their arbitrary combination provide for two separate gas flows. Document D2 taught that, in order to avoid shocks in the system, the vapour to be deposited should not be incorporated into carrier gas. This was teaching away from the claimed invention. The combination of documents D1 and D2 resulted from an inadmissible *ex-post-facto* analysis. Furthermore, neither document disclosed or suggested a carrier gas carrying an organic material, where a guard flow was provided around the carrier gas. Both documents disclosed only one gas flow, i. e. the carrier gas, whereas according to the invention an additional flow was claimed.

Reasons for the Decision

1. Amendments

1.1 Article 76(1) EPC 1973

1.1.1 The present application is a divisional application within the meaning of Article 76 EPC 1973 of the earlier application (parent application) with application number 04 796 037.

1.1.2 Claims 1 and 8 are based on claim 11 and on the combination of claims 11 and 21 of the parent application, respectively.

Dependent claims 2 and 3 are based on claims 12 and 13 of the parent application, respectively. Dependent claim 5 is based on the combination of claims 1, 2, 4,

and 6 of the parent application. Dependent claims 6 to 7 and 9 to 11 are based on claims 7 to 8 and 22 to 24 of the parent application, respectively. Dependent claims 12 and 13 are based on claim 25 of the parent application. Finally, claims 14 and 15 are based on claims 29 and 30 of the parent application, respectively.

1.1.3 In the decision the examining division held that claim 4 did not have a basis in the parent application. In particular, claim 4 was based on claims 1, 2, 4, and 5 of the parent application. However, the method according to these claims did not provide a guard flow *around the carrier gas* (contested decision, point 2.1.3 of the Reasons).

The board notes that claim 4 is dependent on claim 1, in which the provision of a guard flow around the carrier gas is specified. As pointed out above, claim 1 is based on claim 11 of the parent application, in which it is explicitly specified that the claimed method comprises the step of providing a guard flow around the carrier gas. This is also in line with the corresponding embodiment of the invention having a guard flow, according to which the guard flow enters second gas inlet 222 of jacket 220 and is thus provided around the carrier gas which enters the first gas inlet 212 of nozzle tube 210 (see Figure 2 and paragraph [0030] of the parent application).

The additional features of claim 4 relate to the dynamic pressure between the nozzle and the substrate surrounding the carrier gas being at least 1333 Pa and the background atmosphere being ambient atmosphere at about 101,325 Pa. These features are disclosed in combination with the features of claim 1, in particular

the guard flow, in claims 1, 2, 4, and 5 of the parent application. It is evident for the skilled person that the expression "guard flow" in claims 4 and 11 of the parent application refers to the same flow which is provided around the carrier gas and is intended to confine the carrier gas.

Consequently, claim 4 has a basis in the parent application.

1.1.4 The description has been brought into conformity with the amended claims and supplemented with an indication of the relevant content of the prior art without extending beyond the content of the parent application.

1.1.5 Accordingly, the board is satisfied that the amendments comply with the requirements of Article 76(1) EPC 1973.

1.2 Article 123(2) EPC

Claims 1 and 8 are based on claim 1 and on the combination of claims 1 and 8 of the application as filed, respectively.

Dependent claims 2 to 7 and 9 to 15 are based on claims 2 to 7 and 9 to 15, respectively, of the application as filed.

The description has been brought into conformity with the amended claims and supplemented with an indication of the relevant content of the prior art without extending beyond the content of the application as filed.

Accordingly, the board is satisfied that the amendments comply with the requirements of Article 123(2) EPC.

2. Inventive step

2.1 Closest state of the art

2.1.1 In the contested decision the examining division assessed inventive step starting from document D1 as well as from document D2 as the closest state of the art (contested decision, penultimate paragraph of page 3, paragraph 2 of page 5).

2.1.2 It is established case law that, when selecting the closest state of the art, a central consideration is that it must be directed to the same purpose or effect as the claimed invention; otherwise it cannot lead the skilled person in an obvious way to the claimed invention (see *Case Law of the Boards of Appeal of the EPO*, 8th edition 2016, section I.D.3.2).

2.1.3 Document D2 is concerned with applying a coating on a substrate using a directed vapour deposition approach. In particular, an evaporated vapour flux, which is generated by impinging an electron beam on an evaporant source, is deflected by a carrier gas stream. The envisaged coatings are primarily thermal barrier coatings for the thermal protection of engine components, where the evaporant sources are metals, metal alloys or metal oxides (see document D2, page 5, line 14 - page 6, line 12; page 16, line 23 - page 18, line 16).

2.1.4 As document D2 is not concerned with depositing an organic material it is not directed to the same purpose or effect as the claimed invention. On the other hand, document D1 discloses subject-matter that is conceived for this purpose and has the most relevant technical

features in common with it, as detailed below. Document D1 is therefore considered the closest state of the art.

2.2 Distinguishing features

2.2.1 The examining division held in the contested decision that the subject-matter of claim 1 differed from document D1 in that a guard flow is used (contested decision, page 4, first paragraph).

2.2.2 Document D1 discloses (see paragraphs [0012]-[0014] and [0051]-[0052], Figure 9) a process and apparatus for organic vapour jet deposition. Organic vapours are carried by an inert gas from a source cell 910 into a timed valve 920. The source cell 910 is preferably kept at temperature T and the inert carrier gas is moving at a flow rate V. The opening and closing of the timed valve 920 is preferably regulated throughout the process of patterned deposition. When the timed valve 920 is open, the inert gas carrying the organic vapours moves through the timed valve 920 and into the nozzle block 930. From the nozzle block 930, the organic vapours in the inert carrier gas are ejected out through the nozzle onto a substrate 950, whereon the organic vapours condense to form a patterned layer 960. In an embodiment the carrier gas rate V is increased so that the bulk flow velocity is at least on the order of the thermal velocity of the molecules, about 100-1000 m/s, creating a jet of material that is unidirectional.

Hence, using the wording of claim 1, document D1 discloses a method of depositing an organic material (patterned layer 960 of condensed organic vapours), comprising:

ejecting a carrier gas (inert carrier gas) carrying

an organic material (organic vapours) from the nozzle (nozzle of nozzle block 930) at a flow velocity that is at least 10% of the thermal velocity of the carrier gas (the bulk flow velocity is at least on the order of the thermal velocity of the molecules), such that the organic material (patterned layer 960 of condensed organic vapours) is deposited onto a substrate (substrate 950).

2.2.3 Document D1 does not disclose a guard flow. Accordingly, the board agrees with the examining division in that the subject-matter of claim 1 differs from the method of document D1 in comprising step (i) of providing a guard flow around the carrier gas.

2.3 Objective technical problem

2.3.1 The examining division held in the contested decision that the effect of the distinguishing feature was that the jet was better confined and that it was the objective technical problem to obtain a better confined jet (contested decision, page 4, paragraph 1).

2.3.2 The examining division's formulation of the objective technical problem contains in the board's view elements of hindsight. In order to arrive at a realistic formulation it has to be taken into account, why the jet should be confined. In this respect the following statement on page 8, paragraph [0032], in the description of the application is of interest:

> "An appropriate guard flow may confine the carrier gas and the molecules being deposited, and prevent them from spreading. Thus, a desirable sharper and higher resolution may be achieved."

It is thus evident that the jet is confined by the guard flow in order to achieve a higher resolution when depositing the organic material. This is particularly relevant when patterning organic materials for opto-electronic devices, e. g. organic light emitting devices (OLEDs), of diminishing size (see paragraphs [0002]-[0003] of the description of the application). The closest state of the art document D1 is also concerned with such devices (see D1, paragraph [0004]). When starting form this document it would therefore be a realistic aim for the skilled person to improve the resolution of the deposition method. The objective technical problem is therefore to provide a method of depositing an organic material having a higher resolution.

2.4 Obviousness

2.4.1 The examining division was of the opinion that document D2 disclosed an additional gas flow surrounding the vapour jet and that it was obvious to combine the teaching of document D2 with that of document D1 thereby arriving at the claimed subject-matter (contested decision, page 4, paragraph 1 - page 5, paragraph 2).

2.4.2 As pointed out above under point 2.1.3 document D2 is concerned with applying a coating on a substrate. The envisaged substrates are engine parts, in particular turbine blades. For example, the coating of turbine blades is described in document D2 on page 14, line 15 to page 16, line 8 with reference to Figures 11 to 14 and 15A to 15C in various configurations concerning the evaporant sources 125a, 125b, 125c, the carrier gas streams 105a, 105b, 105c, and the size and number of the turbine blades 120, 120a to 120g.

Since document D2 is not concerned with depositing patterns on a substrate, but with coating the entire surface of a substrate or at least a large part of it, the skilled person would not consider consulting document D2 when attempting to increase the resolution of the deposition method of the closest state of the art document D1.

2.4.3 In detail it is foreseen according to the deposition method of document D2 (see page 10, lines 3-15, page 12, lines 19-32; Figures 4, 7a, 7b) that a carrier gas 105 is realigned so that it is substantially in line with the crucible 110 retaining the evaporant source. In this alignment, the carrier gas flow is placed completely or substantially around the crucible 110 so that the vapour flux 115 can be simply focused onto the substrate located directly above the evaporant source 125. The nozzle 130 has a nozzle gap or opening 132, through which the carrier gas 105 flows, and is designed such that a more optimal carrier gas speed distribution for focusing the vapor 115 is produced. An electron beam gun 103 generates an electron beam impinging on the evaporant source 125 for generating the evaporated vapour flux 115. In particular, a ring-shaped nozzle opening 132 may be used for increasing the deposition efficiency.

2.4.4 The examining division held that the carrier gas of document D2 did not correspond to the claimed carrier gas but to the claimed guard flow (contested decision, paragraph bridging pages 4 and 5).

However, the board agrees with the appellant that document D2 discloses only one gas flow, namely the carrier gas flow, whose function it is to transport the

vapour of the coating material onto the object to be coated. This emerges also from the paragraph bridging pages 11 and 12 cited by the examining division in this respect: the vapour stream can be altered by changing the carrier flow rate, the ratio of upstream to downstream pressures and the size of the nozzle opening. Therefore, the carrier gas of document D2 has the same function as the inert gas of document D1 (see document D1, paragraph [0052]). Hence, even if the skilled person were to contemplate combining the teachings of documents D1 and D2, he would not provide the carrier gas of document D2 *in addition to* the inert gas of document D1. Consequently, even such a combination would not lead the skilled person to the claimed subject-matter.

2.4.5 In view of the above, the subject-matter of claim 1 involves an inventive step. Independent device claim 8 corresponds essentially to method claim 1. Claims 2 to 7 and 9 to 15 are dependent on claims 1 and 8, respectively.

Accordingly, the subject-matter of claims 1 to 15 involves an inventive step (Article 52(1) EPC and Article 56 EPC 1973).

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the examining division with the order to grant a patent in the following version:

- Claims 1 to 15 as filed with the letter dated 18 August 2016;
- Description: pages 3, 3a to 3c, 5 to 8, 12, 15, and 17 as filed with letter dated 20 April 2017, page 18 as filed with letter dated 18 August 2016, and pages 1, 2, 4, 9 to 11, 13, 14, and 16 as originally filed;
- Drawings: sheets 1/15 to 15/15 as originally filed.

The Registrar: The Chairman:

T. Buschek G. Eliasson

Decision electronically authenticated