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Datasheet for the decision of 2 March 2012

Case Number: T 0870/08 - 3.5.02

Application Number: 01304145.4

Publication Number: 1156584

IPC: H03H3/02, H03H9/17

Language of the proceedings: EN

Title of invention:
A method for shaping thin film resonators to shape acoustic modes therein

Applicant:
Agere Systems Guardian Corporation

Headword:

Relevant legal provisions:
EPC Art. 84, 123(2), 54, 56

Keyword:
Missing essential features - Yes (main and first auxiliary requests)
Novelty and inventive step - Yes (second auxiliary request)

Decisions cited:

Catchword:

Case Number: T0870/08 - 3.5.02

D E C I S I O N
of the Technical Board of Appeal 3.5.02
of 2 March 2012

Appellant: (Applicants)
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Decision under appeal:
Decision of the Examining Division of the European Patent Office posted 7 November 2007 refusing European patent application No. 01304145.4 pursuant to Article 97(1) EPC 1973.

Composition of the Board:

Chairman: M. Rognoni
Members: R. Lord
R. Moufang

Summary of Facts and Submissions

I. This is an appeal of the applicant against the decision of the examining division to refuse European patent application No. 01 304 145.4. The reason given for the refusal was that the independent claim 1 then on file was not clear, and thus did not comply with the requirements of Article 84 EPC.

II. The following document of the state of the art has been cited during the procedure before the first instance:

D1: US 5 650 075 A.

III. In a communication accompanying a summons to oral proceedings, dated 23 November 2011, the board informed the appellant *inter alia* of its preliminary opinion that the independent claim 1 of the main request as filed with the appellant's grounds of appeal (letter dated 14 March 2008) lacked technical features which were essential to the invention as described in the application, and was thus unclear, contrary to the requirements of Article 84 EPC.

With a letter dated 1 February 2012 the appellant filed amended sets of claims according to a main request and first to fifth auxiliary requests. In this letter they presented arguments relating to the basis for the amendments, the clarity of the amended claims, and novelty and inventive step in the subject-matter of these claims.

With a letter dated 27 February 2012, following a telephone conversation between the rapporteur of the board and the appellant's representative on 24 February 2012, the appellant filed an amended set of claims and

pages 9 an 10 of the description replacing those of the previous second auxiliary request. In this letter they also indicated that they would not attend the scheduled oral proceedings.

Oral proceedings before the board took place on 2 March 2012, at which the appellant was not represented.

The appellant's written requests were in effect that the decision under appeal be set aside and that a patent be granted on the basis of claims 1 to 16 according to the main request or claims 1 to 18 according to the first auxiliary request, both filed with letter dated 1 February 2012, or on the basis of claims 1 to 16 according to the second auxiliary request filed with letter dated 27 February 2012, or on the basis of claims 1 to 17 according to the third auxiliary request, claims 1 to 16 according to the fourth auxiliary request or claims 1 to 15 according to the fifth auxiliary request, all filed with letter dated 1 February 2012.

Each of these sets of claims was to be accompanied by the description and drawings which formed the basis of the decision under appeal (i.e. description pages 2, 3, 5 and 7 to 11 as originally filed and pages 1, 4, 6 and 12 as filed with letter dated 14 June 2007, and drawings pages 1/5 to 5/5 as originally filed), with the exception that in the second auxiliary request the description pages 9 and 10 as originally filed were to be replaced with the corresponding pages filed with letter dated 27 February 2012.

IV. Claim 1 of the appellant's main request reads as follows:

"A method for photolithographic shaping of high frequency thin film acoustic resonators (30), comprising the steps of:
forming a layer of masking material (22) on a thin film resonator substrate (21); and
patterning the layer of masking material using photolithography;
characterized in that
the method further comprises the steps of:
utilizing one of a heating schedule and a vapor cycle to shape the patterned masking material (23) into a predetermined physical structure (24) that is different from the physical structure of the masking material after patterning; and
removing material from the acoustic resonator (30) by etching to shape the acoustic resonator (30) such that the acoustical modes within the acoustic resonator are shaped,
wherein said etching comprises one of doming the resonator, dishing the resonator, forming multiple domes within the resonator, forming a wash-board like structure having multiple high and low rows, or forming radial patterns."

Claim 1 of the appellant's first auxiliary request differs from that of the main request in that the final paragraph is deleted and the penultimate paragraph is replaced by the following:

"removing material from the acoustic resonator (30) to shape the acoustic resonator (30) to be thicker in its middle such that the acoustical modes within the acoustical resonator are shaped."

Claim 1 of the appellant's second auxiliary request differs from that of the first auxiliary request in

that the final two paragraphs are replaced by the following:

"utilizing one of a heating schedule and a vapor cycle to shape the patterned masking material (23) into a predetermined physical structure (24) being thicker in its middle than at its periphery and different from the physical structure of the masking material after patterning; and
removing material from the shaped masking material (24) and from the substrate (21) to shape the acoustic resonator (30) to be thicker in its middle than at its periphery such that the acoustical modes within the acoustic resonator are shaped."

Claims 2 to 16 of the second auxiliary request are dependent on claim 1.

V. The arguments of the appellant which are relevant for the present decision are as follows:

The amendments to claim 1 of the main request and the first auxiliary request defined the shape of the resonator resulting from the etching process, and therefore clearly defined how the acoustical modes within the resonator are shaped.

The amendments to claim 1 of the second auxiliary request had a basis in page 4, lines 5 and 6 of the description, in combination with Fig. 3, and in page 8, lines 10 to 14, thus meeting the requirements of Article 123(2) EPC. Moreover, they resulted in the claim defining clearly the missing essential features identified by the board in the communication of 23 November 2011, so that the claim met the requirements of Article 84 EPC.

The document D1 did not disclose shaping the masking material after patterning so as to be thicker in the middle than at its periphery, or that the step of removing material includes removing material from both the masking material and the substrate so as to transfer that shape to the resonator. In particular D1 neither disclosed nor suggested the use of a heating schedule or a vapour cycle to shape the masking material in order to achieve the desired shaping of the acoustical modes of the resonator. Therefore the claimed subject-matter was novel and involved an inventive step.

Reasons for the Decision

1. The appeal is admissible.

2. *Main request*

2.1 From the description of the present application (see in particular paragraphs [0015] and [0016] of the published application) it is apparent that the application is concerned with a method of processing a thin film acoustic resonator so as to provide it with a variable thickness profile so as to guide the acoustic waves in a desired manner. Specifically, as described in paragraph [0016] and in paragraphs [0006], [0007] and [0009], it is desired to form the resonator in such a manner that it is thicker in the middle than at its periphery, so as to reduce energy losses. As indicated in general terms in paragraph [0007], and described in more detail in paragraphs [0015] and [0016], this

profile is achieved by firstly shaping a patterned masking material using a heat treatment ("*heating schedule*") or vapour cycle, so that it changes its shape to be thicker in the middle than at its periphery, and secondly using a material removal process, such as etching, to remove material from both the shaped masking layer and the resonator substrate, so as to transfer the profile of the shaped masking layer into the resonator.

2.2 The independent claim 1 of the appellant's main request does not define that the structure of the patterned masking material resulting from the heat treatment or vapour cycle is one with a variable thickness profile, nor does it define that the etching process is one which removes material not only from the substrate, but also from the shaped masking material, thereby transferring the profile of the masking material into the resonator, or that it is this aspect of the etching process which results in the shaping defined in the last paragraph of the claim. Therefore the claim does not include all of the essential features identified in paragraph 2.1 above, so that the claim does not clearly define the invention. Hence the claim does not meet the requirements of Article 84 EPC.

2.3 The appellant's arguments relating to the clarity of this claim concern only the manner in which the acoustical modes of the resonator are shaped (i.e. the shape of the resonator resulting from the method), and thus address only the objection under Article 84 EPC raised in the decision under appeal, not the objection of missing essential features discussed above. These arguments therefore have no influence on the conclusion indicated in paragraph 2.2 above.

3. *First auxiliary request*

3.1 The above argumentation relating to claim 1 of the main request applies correspondingly to claim 1 of the first auxiliary request, since this claim also does not define either that the structure of the patterned masking material resulting from the heat treatment or vapour cycle is one with a variable thickness profile, or that the etching process is one which removes material not only from the substrate, but also from the shaped masking material, thereby transferring the profile of the masking material into the resonator, or that it is this aspect of the etching process which results in the shaping defined in the last paragraph of the claim.

3.2 The comment in paragraph 2.3 above concerning the appellant's counter-arguments applies also to their arguments relating to the clarity of this request. Therefore claim 1 of the first auxiliary request does not meet the requirements of Article 84 EPC.

4. *Second auxiliary request - Amendments*

4.1 Compared to claim 1 of the original application, claim 1 of this request contains the following additional features:

(a) the steps of forming the layer of masking material on the substrate of the thin film resonator and patterning that layer by photolithography;
(b) that the structure formed in the masking material by the heating schedule or vapour cycle is different from that resulting from the patterning,

and is thicker at its middle than at its periphery; and

(c) that the step of removing material acts on the shaped masking material as well as the resonator, and is carried out such that the resonator is also thicker in the middle than at its periphery, thereby shaping the acoustical modes of the resonator.

4.2 The first of these amendments represents merely the inherently necessary steps of preparing the masking material for the heating schedule or vapour cycle which was already defined in the original claim 1, as depicted in Fig. 3 of the application. The second and third amendments define the desired shape of the shaped masking material, the manner in which this is transferred into the resonator, and the effect this has on the acoustical modes of the resonator, as disclosed in particular in paragraph [0007] of the published application (i.e. in the "Summary of the Invention"). As discussed in paragraph 2.1 above, from this passage and from the detailed description of the method (paragraphs [0015] to [0017]) it is clear that these are in fact essential features of the claimed invention, so that their introduction into the independent claim cannot result in added subject-matter within the meaning of Article 123(2) EPC.

4.3 The dependent claims have been adapted to use terminology consistent with that of claim 1 and to exclude those aspects which are not consistent with claim 1. The description has similarly been amended to clarify which aspects no longer fall within the scope of the claims.

4.4 The amendments to this request therefore meet the requirements of Article 123(2) EPC.

5. *Second auxiliary request - Clarity*

The amendments to claim 1 of the second auxiliary request as indicated in paragraph 4.1 above include all of the essential technical features identified as being missing from the independent claims of the main and first auxiliary requests. The objections raised against those claims under Article 84 EPC therefore do not apply to this claim.

6. *Second auxiliary request - Novelty and inventive step*

6.1 D1 represents a typical example of the available prior art relating to high frequency thin film resonators, and discloses a method according to the pre-characterising portion of claim 1 of this request. D1 does not however disclose the step of using a heating schedule or a vapour cycle to shape the patterned mask material in the manner defined in the first step of the characterising portion. D1 does, on the other hand, disclose a step of removing material from the substrate, but not one of removing material from both the shaped masking material and the substrate, as defined in the second step of the characterising portion of the present claim. Hence it also does not disclose the resultant shape of the resonator and the effect of that shape on the acoustical modes. Therefore the subject-matter of the present claim 1 is new with respect to D1. The other available prior art relating to high frequency thin film acoustic resonators is similar in terms of this disclosure.

6.2 As acknowledged in the present application (see paragraph [0009]), the skilled person was aware that it was desirable to form acoustical resonators in a dome shape. However, as also indicated there, the known mechanical techniques for forming such shapes in low frequency devices are not suitable for high frequency devices.

6.3 Similarly, it is acknowledged in the present application (see paragraph [0012]) that a shaping technique similar to that defined in the characterising portion of claim 1 was known in the technical field of microlens fabrication. However, the board notes that microlens technology differs in several significant aspects from that of the present application. Firstly, the general technical field (optics) is entirely different from the field of using acoustic waves for electrical signal processing. Secondly, the amorphous materials used (glass or plastics) are quite different from the crystalline materials used for thin film acoustic resonators. Thirdly, the constructional aspects are different in that for microlenses the (light) waves pass perpendicularly through the substrates, so that the curved surface acts to refract them, whereas in a thin film acoustic resonator the acoustic waves propagate in the plane of the substrate, and thus (in the device fabricated according to the claimed invention) do not pass through the curved surface. In the light of these differences, the board considers that the skilled person, wishing to form a high frequency thin film acoustic resonator with a domed or similar shape, would not have considered it obvious to take into account a technique known from the field of microlenses. Therefore, and since the available prior art contains no further teaching with respect to this technique, the board concludes that the

subject-matter of claim 1 of the appellant's second auxiliary request involves an inventive step according to Article 56 EPC.

6.4 In its communication of 8 December 2006, the examining division raised objections of lack of novelty or lack of inventive step against all of the claims as originally filed. However, the board considers that none of those objections apply to the subject-matter of the present claim 1, since the original claims did not include either the feature that the shaping of the patterned masking material resulted in it being thicker at its middle than at its periphery or the feature that the step of removing material comprises removing material from both the shaped masking material and the substrate so as to transfer the shape of the masking material into the resonator.

7. The amendments introduced in the amended pages 1, 4, 6 and 12 of the description address the remaining deficiencies of the original application, in particular those relating to Rule 42(1)(b) and (c) EPC. Therefore the second auxiliary request meets all the relevant requirements of the EPC.

8. Given the above conclusion concerning the second auxiliary request, it is not necessary to consider the appellant's third to fifth auxiliary requests.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to grant a patent in the following version:

Description: pages 2, 3, 5, 7, 8 and 11 as originally filed,
pages 1, 4, 6 and 12 filed with letter dated 14 June 2007,
pages 9 and 10 filed with letter dated 27 February 2012,
Claims: 1 to 16 filed with letter dated 27 February 2012,
Drawings: sheets 1/5 to 5/5 as originally filed.

The Registrar: The Chairman:

U. Bultmann M. Rognoni

Decision electronically authenticated