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Datasheet for the decision of 4 February 2014

Case Number: T 2309/10 - 3.3.10

Application Number: 02757791.5

Publication Number: 1390664

IPC: F21V9/00, C07C391/00, C07C319/00

Language of the proceedings: EN

Title of invention:
MATERIALS, METHODS, AND USES FOR PHOTOCHEMICAL GENERATION OF ACIDS AND/OR RADICAL SPECIES

Applicant:
The Arizona Board of Regents on behalf of the University of Arizona

Headword:

Relevant legal provisions:
EPC Art. 56, 113(1)

Keyword:
Inventive step - (no) - all requests

Decisions cited:

Catchword:

Beschwerdekammern
Boards of Appeal
Chambres de recours

European Patent Office
D-80298 MUNICH
GERMANY
Tel. +49 (0) 89 2399-0
Fax +49 (0) 89 2399-4465

Case Number: T 2309/10 - 3.3.10

D E C I S I O N
of Technical Board of Appeal 3.3.10
of 4 February 2014

Appellant: (Applicant)	The Arizona Board of Regents on behalf of the University of Arizona 888 North Euclid Avenue Room 204 Tucson, AZ 85721-0158 (US)
Representative:	Ahner, Philippe BREVALEX 95 rue d'Amsterdam 75378 Paris Cedex 8 (FR)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 21 June 2010 refusing European patent application No. 02757791.5 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: P. Gryczka
Members: R. Pérez Carlón
D. Rogers

Summary of Facts and Submissions

I. The appeal lies from the decision of the examining division to refuse European patent application No. 02 757 791.5.

II. *Inter* alia, the following documents were cited by the examining division:

D1: WO 99/53242
D2: WO 98/21521

III. During the appeal procedure, the following document has been cited by the appellant (applicant):

D5: Rumi *et al. J. Am. Chem. Soc.* **2000**, *J22*, 9500-9510

IV. The examining division considered *inter alia* that document D1 was the closest prior art for the subject-matter of all the requests then pending, and that the problem underlying the claimed invention, which was defined as the provision of further compounds and compositions suitable as two-photon absorbent materials, was not convincingly solved by the features of claim 1 of none of said requests. In the absence of such a solution, an inventive step could not be acknowledged.

V. With the statement setting out the grounds of appeal, the appellant filed a main request and a first and second auxiliary request which are identical to the corresponding requests pending in examination proceedings. A third auxiliary request was filed under cover of a letter dated 3 September 2013.

VI. The parts of the requests relevant for the present decision read as follows:

Claim 1 of the **main request**:

"A compound or composition, comprising:

at least one chromophore having a simultaneous two-photon or multi-photon absorptivity; and

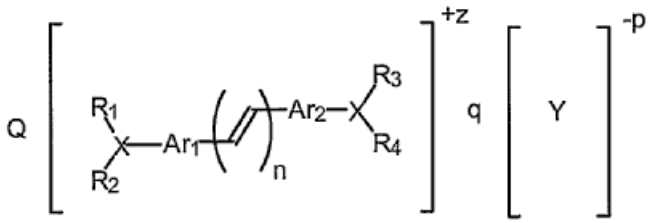
at least one photoacid or radical generator comprising at least one selenonium group in close proximity to said chromophore;

wherein said chromophore has a two-photon absorption cross-section of 50 x 10^{-50} cm^4s/photon."

Claim 1 of the **first auxiliary request** differs from claim 1 of the main request in that it does not relate to "a compound or composition", but only to "a compound".

Claim 1 of the **second auxiliary request** reads as follows:

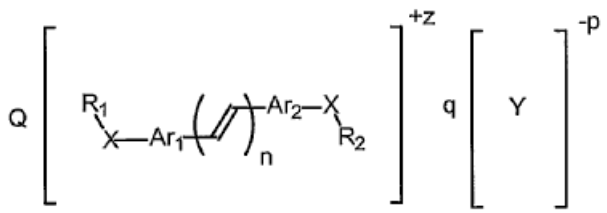
"*A composition selected from the group consisting of compounds having the structure:*



wherein X=Se and n=0, 1, 2, 3, 4, or 5,

wherein Ar_1 and Ar_2 are each independently a 5-membered heteroaromatic ring; a 6-membered aromatic ring; or a 6-membered heteroaromatic ring,
wherein each of Ar_1 and Ar_2 are optionally independently substituted with one or more H, alkyl group, alkoxy group, or aryl group, which groups may be optionally independently substituted with one or more selenonium groups or monomer or pre-polymer groups,
wherein R_1, R_2, R_3, and R_4 are each independently alkyl or aryl groups, which groups may be optionally independently substituted with one or more selenenonium groups; or monomer or pre-polymer groups,
wherein Y is an anion selected from the group consisting of F^-, Cl^-, Br^-, I^-, CN^-, SO_4^{2-}, PO_4^{3-}, $CH_3CO_2^-$, $CF_3SO_3^-$, NO_2^-, NO_3^-, BF_4^-, PF_6^-, SbF_6^-, AsF_6^-, $SbCl_4^-$, ClO_3^-, ClO_4^- and $B(aryl)_4^-$, where aryl is an aryl group containing 25 or fewer carbon atoms that may be optionally substituted with one or more alkyl groups, aryl groups or halogens,
wherein z is an integer equal to the charge of the chromophore portion of the compound,
wherein p is an integer equal to the charge of the anion, and
wherein q and Q are integers such that the relationship $zQ=pq$ is satisfied,

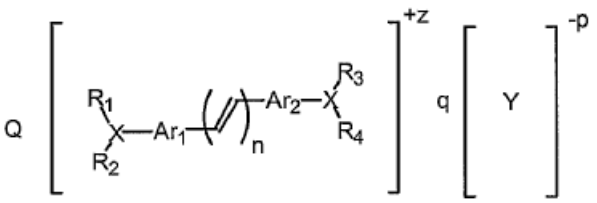
the structure:



wherein X is O and n=1, 2, 3, 4, or 5,

wherein Ar_1 and Ar_2 are each independently a 5-membered heteroaromatic ring; a 6-membered aromatic ring; or a 6-membered heteroaromatic ring,
wherein each of Ar_1 and Ar_2 are optionally independently substituted with one or more H, alkyl group, alkoxy group, or aryl group, which groups may be optionally independently substituted with one or more selenonium groups; or monomer or pre-polymer groups,
wherein R_1 and R_2 are each independently H, alkyl or aryl groups which groups may be optionally independently substituted with one or more selenonium groups; or monomer or pre-polymer groups,
wherein at least one of Ar_1, Ar_2, R_1 or R_2 is substituted with one or more selenonium groups,
wherein Y is an anion selected from the group consisting of F^-, Cl^-, Br^-, I^-, CN^-, SO_4^{2-}, PO_4^{3-}, $CH_3CO_2^-$, $CF_3SO_3^-$, NO_2^-, NO_3^-, BF_4^-, PF_6^-, SbF_6^-, AsF_6^-, $SbCl_4^-$, ClO_3^-, ClO_4^- and $B(aryl)_4^-$, where aryl is an aryl group containing 25 or fewer carbon atoms that may be optionally substituted with one or more alkyl groups, aryl groups or halogens,
wherein z is an integer equal to the charge of the chromophore portion of the compound,
wherein p is an integer equal to the charge of the anion, and
wherein q and Q are integers such that the relationship $zQ=pq$ is satisfied,

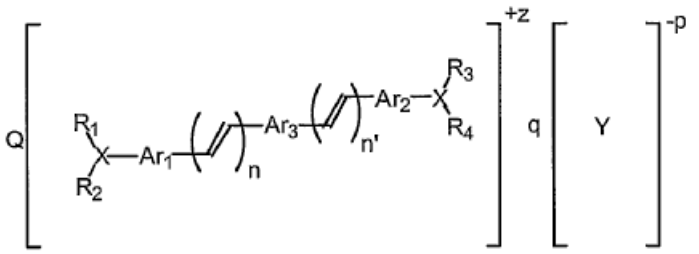
the structure:



wherein X is N and n=0, 1, 2, 3, 4, or 5,

wherein Ar_1 and Ar_2 are each independently a 5-membered heteroaromatic ring; a 6-membered aromatic ring; or a 6-membered heteroaromatic ring,
wherein each of Ar_1 and Ar_2 are optionally independently substituted with one or more H, alkyl group, alkoxy group, or aryl group, which groups may be optionally independently substituted with one or more selenonium groups; or monomer or pre-polymer groups,
wherein R_1, R_2, R_3, and R_4 are each independently H, alkyl group, or aryl group, which groups may be optionally independently substituted with one or more selenonium groups; or monomer or pre-polymer groups,
wherein at least one of Ar_1, Ar_2, R_1, R_2, R_3, or R_4 is substituted with one or more selenonium groups,
wherein Y is an anion selected from the group consisting of F^-, Cl^-, Br^-, I^-, CN^-, SO_4^{2-}, PO_4^{3-}, $CH_3CO_2^-$, $CF_3SO_3^-$, NO_2^-, NO_3^-, BF_4^-, PF_6^-, SbF_6^-, AsF_6^-, $SbCl_4^-$, ClO_3^-, ClO_4^- and $B(aryl)_4^-$, where aryl is an aryl group containing 25 or fewer carbon atoms that may be optionally substituted with one or more alkyl groups, aryl groups or halogens,
wherein z is an integer equal to the charge of the chromophore portion of the compound,
wherein p is an integer equal to the charge of the anion, and
wherein q and Q are integers such that the relationship $zQ=pq$ is satisfied,

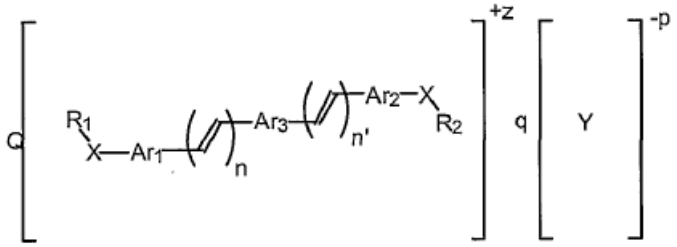
the structure:



wherein X is Se, n=0, 1, 2, 3, 4, or 5, and n'=0, 1, 2, 3, 4 or 5,
wherein Ar_1 and Ar_2 are each independently a 5-membered heteroaromatic ring; a 6-membered aromatic ring; or a 6-membered heteroaromatic ring,
wherein Ar_3 is a 5-membered heteroaromatic ring; a 6-membered aromatic ring; or a 6-membered heteroaromatic ring,
wherein each of Ar_1 and Ar_2 are optionally independently substituted with H, alkyl group, alkoxy group, or aryl group, which groups may be optionally independently substituted with one or more selenonium groups; or monomer or pre-polymer groups,
wherein Ar_3 is optionally independently substituted with one or more H, acceptor group, alkyl group, alkoxy group, aryl group, which groups may be optionally independently substituted with one or more selenonium groups; or monomer or pre-polymer groups,
wherein R_1, R_2, R_3, and R_4 are each independently alkyl group, aryl group, which groups may be optionally independently substituted with one or more selenonium, groups; or monomer or pre-polymer groups,
wherein Y is an anion selected from the group consisting of F^-, Cl^-, Br^-, I^-, CN^-, SO_4^{2-}, PO_4^{3-}, $CH_3CO_2^-$, $CF_3SO_3^-$, NO_2^-, NO_3^-, BF_4^-, PF_6^-, SbF_6^-, AsF_6^-, $SbCl_4^-$, ClO_3^-, ClO_4^- and $B(aryl)_4^-$, where aryl is an aryl group containing 25 or fewer carbon atoms that may be

optionally substituted with one or more alkyl groups, aryl groups or halogens,
wherein z is an integer equal to the charge of the chromophore portion of the compound,
wherein p is an integer equal to the charge of the anion, and
wherein q and Q are integers such that the relationship zQ=pq is satisfied,

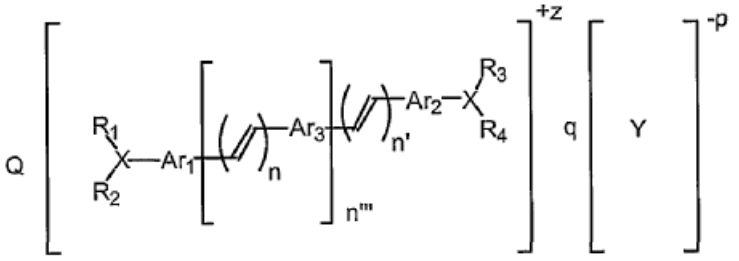
the structure:



wherein X is O and n=0, 1, 2, 3, 4, or 5, and n'=0, 1, 2, 3, 4 or 5,
wherein Ar_1 and Ar_2 are each independently a 5-membered heteroaromatic ring; a 6-membered aromatic ring; or a 6-membered heteroaromatic ring,
wherein Ar_3 is a 5-membered heteroaromatic ring; a 6-membered aromatic ring; or a 6-membered heteroaromatic ring,
wherein each of Ar_1 and Ar_2 are optionally independently substituted with one or more H, alkyl group, alkoxy group, aryl group, which groups may be optionally independently substituted with one or more selenonium groups; or monomer or pre-polymer groups,
wherein Ar_3 is optionally substituted with one or more H, acceptor group, alkyl group, alkoxy group, aryl group, which groups may be optionally independently substituted with one or more selenonium groups; or monomer or pre-polymer groups,

wherein R_1 and R_2 are each independently H, alkyl group, aryl group, which groups may be optionally independently substituted with one or more selenonium groups; or monomer or pre-polymer groups,
wherein at least one of Ar_1, Ar_2, Ar_3, R_1 or R_2 is substituted with one or more selenonium groups,
wherein Y is an anion selected from the group consisting of F^-, Cl^-, Br^-, I^-, CN^-, SO_4^{2-}, PO_4^{3-}, $CH_3CO_2^-$, $CF_3SO_3^-$, NO_2^-, NO_3^-, BF_4^-, PF_6^-, SbF_6^-, AsF_6^-, $SbCl_4^-$, ClO_3^-, ClO_4^- and $B(aryl)_4^-$, where aryl is an aryl group containing 25 or fewer carbon atoms that may be optionally substituted with one or more alkyl groups, aryl groups or halogens,
wherein z is an integer equal to the charge of the chromophore portion of the compound,
wherein p is an integer equal to the charge of the anion, and
wherein q and Q are integers such that the relationship $zQ=pq$ is satisfied,

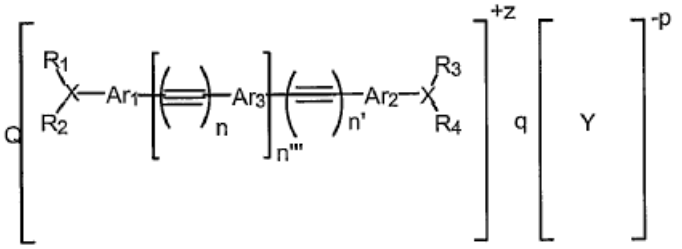
the structure:



wherein X is N and n=0, 1, 2, 3, 4, or 5, and n'=0, 1, 2, 3, 4 or 5 and n'''=0, 1, 2, 3, 4 or 5,
wherein Ar_1 and Ar_2 are each independently a 5-membered heteroaromatic ring; a 6-membered aromatic ring; or a 6-membered heteroaromatic ring,
wherein Ar_3 is a 5-membered heteroaromatic ring; a 6-membered aromatic ring; or a 6-membered heteroaromatic ring,

wherein each of Ar_1 and Ar_2 are optionally independently substituted with one or more H, alkyl group, alkoxy group, aryl group, which groups may be optionally independently substituted with one or more selenonium groups; or monomer or pre-polymer groups,
wherein Ar_3 is optionally substituted with one or more H, acceptor group, alkyl group, alkoxy group, aryl group, which groups may be optionally independently substituted with one or more selenonium groups; or monomer or pre-polymer groups,
wherein R_1, R_2, R_3, and R_4 are each independently H, alkyl group, aryl group, which groups may be optionally independently substituted with one or more selenonium groups; or monomer or pre-polymer groups,
wherein at least one of Ar_1, Ar_2, Ar_3, R_1, R_2, R_3, or R_4 is substituted with one or more selenonium groups,
wherein Y is an anion selected from the group consisting of F^-, Cl^-, Br^-, I^-, CN^-, SO_4^{2-}, PO_4^{3-}, $CH_3CO_2^-$, $CF_3SO_3^-$, NO_2^-, NO_3^-, BF_4^-, PF_6^-, SbF_6^-, AsF_6^-, $SbCl_4^-$, ClO_3^-, ClO_4^- and $B(aryl)_4^-$, where aryl is an aryl group containing 25 or fewer carbon atoms that may be optionally substituted with one or more alkyl groups, aryl groups or halogens,
wherein z is an integer equal to the charge of the chromophore portion of the compound,
wherein p is an integer equal to the charge of the anion, and
wherein q and Q are integers such that the relationship $zQ=pq$ is satisfied,

the structure:



wherein X is N and n=0, 1, 2, 3, 4, or 5, and n'=0, 1, 2, 3, 4 or 5 and n'''=0, 1, 2, 3, 4 or 5,
wherein Ar_1 and Ar_2 are each independently a 5-membered heteroaromatic ring; a 6-membered aromatic ring; or a 6-membered heteroaromatic ring,
wherein Ar_3 is a 5-membered heteroaromatic ring; a 6-membered aromatic ring; or a 6-membered heteroaromatic ring,
wherein each of Ar_1 and Ar_2 are optionally independently substituted with one or more H, alkyl group, alkoxy group, aryl group, which groups may be optionally independently substituted with one or more selenonium groups; or monomer or pre-polymer groups,
wherein Ar_3 is optionally substituted with one or more H, acceptor group, alkyl group, alkoxy group, aryl group, which groups may be optionally independently substituted with one or more selenonium groups; or monomer or pre-polymer groups,
wherein R_1, R_2, R_3, and R_4 are each independently H, alkyl group, aryl group, which groups may be optionally independently substituted with one or more selenonium groups; or monomer or pre-polymer groups,
wherein at least one of Ar_1, Ar_2, Ar_3, R_1, R_2, R_3, or R_4 is substituted with one or more selenonium groups,
wherein Y is an anion selected from the group consisting of F^-, Cl^-, Br^-, I^-, CN^-, SO_4^{2-}, PO_4^{3-}, $CH_3CO_2^-$, $CF_3SO_3^-$, NO_2^-, NO_3^-, BF_4^-, PF_6^-, SbF_6^-, AsF_6^-, $SbCl_4^-$, ClO_3^-, ClO_4^- and $B(aryl)_4^-$, where aryl is an aryl group containing 25 or fewer carbon atoms that may be

optionally substituted with one or more alkyl groups, aryl groups or halogens,
wherein z is an integer equal to the charge of the chromophore portion of the compound,
wherein p is an integer equal to the charge of the anion, and
wherein q and Q are integers such that the relationship zQ=pq is satisfied."

Claim 1 of the **third auxiliary request** differs from claim 1 of the second auxiliary request in that the feature "or monomer or pre-polymer groups" was deleted in every occurrence.

VII. In a communication the board informed the appellant that document D2 appeared to be the closest prior art for the subject-matter of the main request and that the technical problem of providing alternative two-photon absorbent compounds and compositions appeared not to be solved by the features of claim 1 of the main request in the light of the evidence in D2. Said problem had to be reformulated as the mere provision of alternative chemical compounds, and since every compound, irrespectively from its structure, was an obvious solution to this problem, an inventive step could not be acknowledged.

VIII. The appellant argued that the problem as defined above should be regarded as solved in the light of document D5, which reflected different backbones analogous to those of the compounds claimed.

In addition, since sulfur and selenium had the same number of valence electrons, appeared in the same column of the periodic table, had empty orbitals and had, thus, two unpaired electrons in the valence shell,

the data in the application, which related to sulfur compounds, also credibly proved that the claimed compounds containing selenium had two-photon absorptivity.

Independently from whether document D1 or D2 was the closest prior art, the claimed subject-matter was inventive, since none of the documents on file hinted towards compounds containing selenonium groups.

IX. Oral proceedings before the board of appeal took place on 4 February 2014 in the absence of the appellant.

X. The appellant requested in writing that the decision under appeal be set aside and that a patent be granted upon the basis of the main request, or upon the basis of any of the first, second or third auxiliary requests. The main and first and second auxiliary requests were filed with the written statement of the grounds of appeal, the third request was filed under cover of a letter dated 3 September 2013.

XI. At the end of the oral proceedings, the decision was announced.

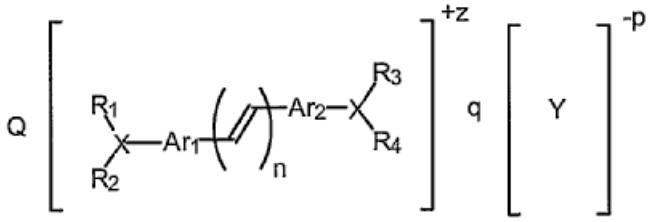
Reasons for the Decision

1. The appeal is admissible.

Third auxiliary request:

2. Claim 1 of the third auxiliary request concerns, *inter alia*, compounds having a styryl backbone and two selenonium groups (see R^1R^2X-, wherein X is selenium) of the general formula below, which can be found on page 155 of the claims, and to which this decision will

refer as "general formula A":



3. Closest prior art:

3.1 In agreement with the finding of the examining division, it is considered that document D1 is the closest prior art.

D1 discloses two-photon or higher-order absorbing optical materials which can be used as polymerisation initiators (page 1, line 22 to page 2, line 5). The first compound depicted on Figure 6 of document D1 is a compound of the general formula A in which n=1, Ar_1=Ar_2=6-membered aromatic ring, R_1=R_2=R_3=R_4=aryl group and z=2. Although figure 6 is silent about the counterion Y, page 18, lines 15-20 of D1 discloses that "all cationic species are accompanied by counterions appropriate to make an electrically complex neutral". The anionic species explicitly mentioned in D1 are Cl^-, Br^-, I^- and SbF_6^-, and all of them fall under the definition of Y in formula A of claim 1.

The first compound on figure 6 of D1 differs thus from the subject-matter of general formula A only in that the atom X is sulfur instead of selenium.

D1, thus, discloses the closest structural approximation to the compounds subject-matter of formula A and relates to the same technical problem and is hence the closest prior art for the claimed subject-

matter represented by general formula A.

3.2 In its communication under Rule 100(2) EPC, the board took the view that document D2 was closest to the broader subject-matter of claim 1 of the main request.

The appellant has chosen not to be represented in the oral proceedings. However, its absence does not prevent the board from deciding upon which prior art is the closest prior art. The appellant should have expected a reaction from the board, in particular in the light of its arguments in response to the board's communication and the newly filed third auxiliary request. For the particular case of the compounds of general formula A of the third auxiliary request, document D1 represents the closest state or the art for the reasons explained above.

Document D1 was also considered the closest prior art by the examining division in the decision under appeal. Taking into account that the aim of appeal proceedings is to review the findings of the impugned decision, in the present case *inter alia* lack of inventive step with respect to D1, and that the appellant has put forward its arguments with respect to D1 in its notice of appeal, the board considers that it is in a position to consider D1 as the closest prior art without breaching the appellant's right to be heard (Article 113(1) EPC).

4. Technical problem underlying the invention:

The technical problem underlying the claimed invention, as formulated by the appellant, lays in providing alternative two-photon absorbent compounds.

5. Solution:

The solution proposed by claim 1 of the main request are *inter alia* compounds of general formula A which contains selenonium groups ($X=Se^+$) instead of sulfonium ($X=S^+$).

6. Success:

In favour of the appellant, the problem underlying the claimed invention as defined in point 4. above is considered solved.

7. Finally, it remains to be examined whether the claimed solution was obvious for the person skilled in the art:

As acknowledged by the appellant in its written submissions from 3 September 2013, the skilled person knows that both sulfur and selenium have the same number of valence electrons and appear in the same column of the periodic table, both have empty orbitals and both have two unpaired electrons in the valence shell. For these reasons the skilled person, trying to obtain an alternative compound to that of document D1, would replace sulfur by selenium and arrive to the compounds of the general formula A of claim 1 of the third auxiliary request without exercising inventive skill.

The appellant argued that D1 failed to mention or suggest selenonium groups, and already for this reason the subject-matter of claim 1 of the third auxiliary request was inventive.

However, the selenonium compounds of general formula A are obvious alternatives for the skilled person in the

light of the general technical knowledge of the person skilled in the art, as acknowledged by the appellant itself. The board is therefore not convinced by this argument of the appellant.

Since at least the compounds of general formula A are not inventive, the broader subject-matter of claim 1 of the third auxiliary including these compounds is, by the same token, not inventive in the sense of Article 56 EPC.

Main request, first and second auxiliary requests:

8. Since the subject-matter of claim 1 of the third auxiliary request and in particular the compounds of general formula A falls within the subject-matter of claim 1 of each of the higher ranked requests on file (see claim 7 of the main request and of the first auxiliary request, claim 1 of the second auxiliary request), it is concluded that the subject-matter of these requests is not inventive for the reasons already explained in points 2. to 7., with the consequence that none of the request on file is allowable.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

C. Rodríguez Rodríguez P. Gryczka

Decision electronically authenticated