

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
1 February 2001 (01.02.2001)

PCT

(10) International Publication Number  
**WO 01/07502 A3**

- (51) International Patent Classification<sup>7</sup>: C08G 61/10, 61/02, C09K 11/06
- (21) International Application Number: PCT/GB00/02850
- (22) International Filing Date: 24 July 2000 (24.07.2000)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
9917356.9 24 July 1999 (24.07.1999) GB
- (71) Applicant (for all designated States except US): **CAMBRIDGE DISPLAY TECHNOLOGY LIMITED** [GB/GB]; Greenwich House, Madingley Rise, Madingley Road, Cambridge CB3 0HJ (GB).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **HOLMES, Andrew, Bruce** [AU/GB]; 19 Newton Road, Cambridge CB2 2AL (GB). **GENESTE, Florence, Danielle, Annie** [FR/FR]; 3 bis, rue Charles Hardouin, F-35530 Noyal Sur Vilaine (FR). **MARTIN, Rainer, Eugen** [AT/DE]; Baslerstrasse 23a, D-79639 Grenzach/Wyhlen (DE). **CACIALLI, Franco** [IT/GB]; 52 Brampton Road, Cambridge CB1 3HL (GB).
- (74) Agents: **DANIELS, Jeffrey, Nicholas et al.**; Page White & Farrer, 54 Doughty Street, London WC1N 2LS (GB).
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- Published:**
- With international search report.
  - Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.
- (88) Date of publication of the international search report:  
22 March 2001
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.



**WO 01/07502 A3**

(54) Title: POLYMERISATION METHOD

(57) Abstract: A method for making a polymer or oligomer comprising the steps of: (a) making a first monomer comprising a substituted aromatic or heteroaromatic group by: (i) providing an aromatic or heteroaromatic group substituted with first and second director groups; (ii) performing metalisation at a first position on the aromatic or heteroaromatic group; (iii) performing electrophilic substitution so as to provide a first substituent group at the first position; and (b) contacting in a reaction mixture the first monomer with at least two further monomers that independently are the same or different from the first monomer under conditions so as to form a polymer or oligomer; wherein the nature and positions of the first and second director groups regioselect the first position.

## INTERNATIONAL SEARCH REPORT

International Application No

PC1/GB 00/02850

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 C08G61/10 C08G61/02 C09K11/06

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C08G C09K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages   | Relevant to claim No.   |
|------------|--|-------------------------|
| A          | WO 98 46652 A (CALIFORNIA INST OF TECHN)<br>22 October 1998 (1998-10-22)<br><br>the whole document   | 1-5,<br>29-33,<br>39-45 |
| Y          | HWANG D -H ET AL: "ELECTROLUMINESCENT<br>PROPERTIES OF NOVEL SILYL-DISUBSTITUTED<br>SOLUBLE PPV DERIVATIVE"<br>MOLECULAR CRYSTALS AND LIQUID CRYSTALS<br>SCIENCE AND TECHNOLOGY. SECTION A.<br>MOLECULAR CRYSTALS AND LIQUID<br>CRYSTALS, GORDON AND BREACH PUBLISHERS,<br>CH, CH,<br>vol. 316, May 1998 (1998-05), pages<br>281-284, XP000941275<br>ISSN: 1058-725X<br>the whole document | 1-5,<br>29-33,<br>39-45 |
|            | -/--   |                         |

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&amp;" document member of the same patent family

Date of the actual completion of the international search

6 November 2000

Date of mailing of the international search report

23 January 2001

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Rousseau, F

## INTERNATIONAL SEARCH REPORT

International Application No

PC1, JB 00/02850

| C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT |   |                         |
|--|---|-------------------------|
| Category °   | Citation of document, with indication, where appropriate, of the relevant passages  | Relevant to claim No.   |
| Y  | <p>DATABASE WPI<br/>Section Ch, Week 199726<br/>Derwent Publications Ltd., London, GB;<br/>Class A25, AN 1997-285197<br/>XP002152054<br/>&amp; JP 09 104732 A (SAMSUNG ELECTRONICS CO LTD), 22 April 1997 (1997-04-22)<br/>abstract</p> <p style="text-align: center;">---</p>  | 1-5,<br>29-33,<br>39-45 |
| Y  | <p>LIAN-HUI WANG ET AL.: "Synthesis,<br/>spectroscopy and electrochemistry study on<br/>a novel di-silyl substituted<br/>poly(p-phenylenevinylene)"<br/>SYNTHETIC METALS,<br/>vol. 105, 9 July 1999 (1999-07-09), pages<br/>85-89, XP000942715<br/>Scheme 1</p> <p style="text-align: center;">---</p>  | 1-5,<br>29-33,<br>39-45 |
| Y  | <p>M.R. ANDERSSON ET AL.: "Photoluminescence<br/>and electroluminescence of films from<br/>soluble PPV-polymers"<br/>SYNTHETIC METALS,<br/>vol. 85, 1997, page 1275-1276 XP000942764<br/>the whole document</p> <p style="text-align: center;">---</p>  | 1-5,<br>29-33,<br>39-45 |
| Y  | <p>SNIECKUS V: "COMBINED DIRECTED ORTHO<br/>METALATION-CROSS COUPLING STRATEGIES.<br/>DESIGN FOR NATURAL PRODUCT SYNTHESIS"<br/>PURE &amp; APPLIED CHEMISTRY, PERGAMON PRESS,<br/>OXFORD, GB,<br/>vol. 66, no. 10/11, 1994, pages 2155-2158,<br/>XP000919008<br/>ISSN: 0033-4545<br/>cited in the application<br/>the whole document</p> <p style="text-align: center;">---</p> | 1-5                     |
| Y  | <p>V. SNIECKUS: "Directed Ortho Metalation.<br/>Tertiary Amide and O-Carbamate Directors<br/>in Synthetic Strategies for<br/>Polysubstituted Aromatics"<br/>CHEMICAL REVIEWS,<br/>vol. 90, no. 6, 1990, pages 879-933,<br/>XP002152053<br/>Scheme 17, page 898</p> <p style="text-align: center;">---</p>   | 1-5                     |
| Y  | <p>J. F. BOWER: "Synthesis of 2-Substituted<br/>Dihydropyran 3-O-Carbamates via Combined<br/>Metalation-Suzuki-Miyaura Cross-Coupling<br/>Reactions"<br/>J. ORG. CHEM.,<br/>vol. 63, no. 5, 1998, pages 1514-1518,<br/>XP000940872<br/>cited in the application<br/>the whole document</p> <p style="text-align: center;">-----</p>   | 1-5                     |

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/GB 00/02850

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.: 1 to 19, 20 to 22, 24, 25, 26, 28, 37, 38 and 39 to 45  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:  
see FURTHER INFORMATION sheet PCT/ISA/210
  
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1.  As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3.  As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:  
29-33, 1-5 (part), 39-45 (part)

### Remark on Protest

- The additional search fees were accompanied by the applicant's protest.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.: 1 to 19, 20 to 22, 24, 25, 26, 28, 37, 38 and 39 to 45

Present claims 1 to 19, 20 to 22, 24, 25, 26, 28, 37 and 38 relate to an extremely large number of possible processes or compounds. In particular claim 1 does not define the type of aromatic or heteroaromatic group utilised, the type of metalation agent used, the agent used for the substitution and the type of polymerization which should be carried out. A meaningful search over the whole of the claimed scope is therefore impossible because claim 1 (resp. claim 20) relates to an extremely large number of possible processes (resp. products). The same applies for claims 2 to 19 (resp. claims 21, 22, 24, 25, 26, 28, 37 and 38) since the combination of features defined therein does not restrict enough the large number of possible processes (resp. products) in such a manner as to render a meaningful search possible. The same holds true for the subject-matter of claims 39 to 45.

Moreover, present claims 25, 26, 37 and 38 relate to the above defined polymers, wherein a desirable luminescent property and a band gap in the range 1.5 eV to 3.5 eV are defined. An attempt is made to define the polymers by reference to a result to be achieved, without defining the features of the polymers which are necessary in order to achieve said result. These claims therefore do meet the requirements of Art 6 PCT. Again, this lack of clarity in the present case is such as to render a meaningful search over the whole of the claimed scope impossible.

Consequently, a search can be carried out only for those parts of the claims which appear to be supported by the description, namely those parts relating to polymers as defined in present claims 23, 27, 29 to 33 and 34 to 36, their method of synthesis as defined in present claim 9 and their use in optical devices (claims 39 to 45).

The applicant's attention is drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 29-33, 1-5 (part), 39-45 (part)

Polymers as defined in claims 29 to 33, their method of synthesis as defined in present claims 1 to 5 and their use in optical devices (claims 39 to 45), i.e. parts relating to polyphenylenevinylene comprising two different silyl substituent groups X' and Y', where X' is ortho to a first linked position and Y' is ortho to the vinylene group.

2. Claims: 34-36, 1-5 (part), 39-45 (part)

Polymers as defined in claims 34 to 36, to their method of synthesis as defined in present claims 1 to 5 and their use in optical devices (claims 39 to 45), i.e. parts relating to polyphenylenevinylene comprising two identical silyl substituent groups namely a dimethyldecylsilyl substituent which are ortho to a first linked position and ortho to the vinylene group.

3. Claims: 27, 1-5 (part), 39-45 (part)

Polymers as defined in claim 27, to their method of synthesis as defined in present claims 1 to 5 and their use in optical devices (claims 39 to 45).

4. Claims: 23 (part), 1-5 (part), 39-45 (part)

Polymers as defined in claim 24 when referring to claim 23 (polymers wherein the first and second director groups are as defined in present claim 9 to 11 and which are not those defined in claim 27), to their method of synthesis as defined in present claims 1 to 5 and their use in optical devices (claims 39 to 45).

5. Claims: 23 (part), 1-5 (part), 39-45 (part)

Polymers as defined in claim 23 wherein X and Y are not as defined in present claims 9 to 11 (i.e. which are not those as defined in present claim 24), to their method of synthesis as defined in present claims 1 to 5 and their use in optical devices (claims 39 to 45).

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/02850

| Patent document<br>cited in search report |   | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|---|---|---------------------|----------------------------|---------------------|
| WO 9846652                                | A | 22-10-1998          | AU 7251898 A               | 11-11-1998          |
| -----                                     |   |                     |                            |                     |
| JP 9104732                                | A | 22-04-1997          | NONE                       |                     |
| -----                                     |   |                     |                            |                     |