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61/268,119 9 June 2009 (09.06.2009) US(71) Applicants (for all designated States except US): **THE BOARD OF TRUSTEES OF THE UNIVERSITY OF ILLINOIS** [US/US]; 506 South Wright Street, Urbana, IL 61081 (US). **QUANTUM ELECTRO OPTO SYSTEMS SDN. BHD.** [MY/MY]; Melaka Media House, Mitc City, 75450, Ayer Keroh, Melaka (MY).

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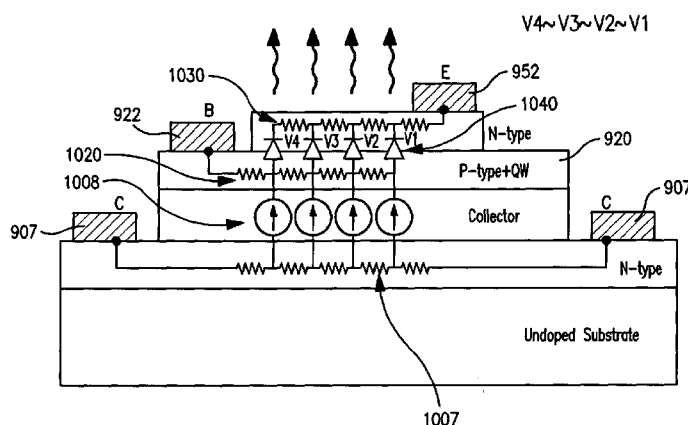
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[Continued on next page]

(54) Title: LIGHT EMITTING SEMICONDUCTOR METHODS AND DEVICES

**FIG. 10**

(57) **Abstract:** A method for producing light emission from a two terminal semiconductor device with improved efficiency, includes the following steps: providing a layered semiconductor structure including a semiconductor drain region comprising at least one drain layer, a semiconductor base region disposed on the drain region and including at least one base layer, and a semiconductor emitter region disposed on a portion of the base region and comprising an emitter mesa that includes at least one emitter layer; providing, in the base region, at least one region exhibiting quantum size effects; providing a base/drain electrode having a first portion on an exposed surface of the base region and a further portion coupled with the drain region, and providing an emitter electrode on the surface of the emitter region; applying signals with respect to the base/drain and emitter electrodes to obtain light emission from the base region; and configuring the base/drain and emitter electrodes for substantial uniformity of voltage distribution in the region therebetween. In a further embodiment lateral scaling is used to control device speed for high frequency operation.



— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

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27 January 2011

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2010/001133**A. CLASSIFICATION OF SUBJECT MATTER****H01S 3/0941(2006.01)i, H01S 3/00(2006.01)i**

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)

H01S 3/0941; H01L 31/12; H01S 3/19; H01L 33/00; H01L 31/109; H01L 21/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: light, emit, quantum, effect

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5796714 A (CHINO TOYOJI et al.) 18 August 1998 See column 5, line 38 - column 25, line 3; abstract and figures 1-21.	1-7, 10-24, 27-42 , 47-67
A	US 2005-0040387 A1 (MILTON FENG et al.) 24 February 2005 See paragraph [0040] - paragraph [0121]; abstract and figures 1-30B.	1-7, 10-24, 27-42 , 47-67
A	US 4176367 A (UEMATSU; YUTAKA) 27 November 1979 See abstract and figures 1-2.	1-7, 10-24, 27-42 , 47-67

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

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"E" earlier application or patent 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 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

"&" document member of the same patent family

Date of the actual completion of the international search

24 NOVEMBER 2010 (24.11.2010)

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2010/001133**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 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.:
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:
3. ☒ Claims Nos.: 8,9,25,26,43-46
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

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

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.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2010/001133

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US 4176367 A	27.11.1979	None	