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(71) Applicant: **OPTONET, INC.** [US/US]; 828 Davis Street, Suite 206, Evanston, IL 60201 (US).

(72) Inventor: **HUANG, Yingyan**; 230 Locust Rd., Wilmette, IL 60091 (US).

(74) Agents: **SCHERER, Christopher, M.** et al.; Andrus Intellectual Property Law, LLP, 100 East Wisconsin Avenue, Suite 1100, Milwaukee, WI 53202 (US).

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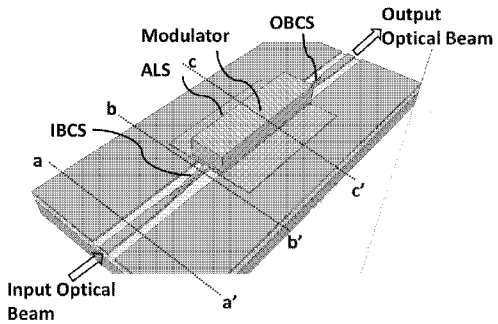

Fig. 4a

(57) Abstract: Integrated optical intensity or phase modulators capable of very low modulation voltage, broad modulation bandwidth, low optical power loss for device insertion, and very small device size are of interest. Such modulators can be of electro-optic or lectro-absorption type made of an appropriate electro-optic or electro-absorption material in particular or referred to as an active material in general. An efficient optical waveguide structure for achieving high overlapping between the optical beam mode and the active lectro-active region leads to reduced modulation voltage. In an embodiment, ultra-low modulation voltage, high-frequency response, and very compact device size are enabled by a semiconductor modulator device structure, together with an active semiconductor material that is an electro-optic or electro-absorption material that are appropriately doped with carriers to substantially lower the modulator voltage and still maintain the high frequency response. In another embodiment, an efficient optical coupling structure further enables low optical loss.

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
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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)
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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 practicable, search terms used)
MicroPatent (US Granted, US Applications, EP-A, EP-B, WO, JP, DE-G, DE-A, DE-T, DE-U, GB-A, FR-A); ProQuest (Derwent, INSPEC, NTIS, PASCAL, Current Contents Search, Dissertation Abstracts Online, Inside Conferences); IP.com; Google Scholar; KEYWORDS: optic*, phase*, intensity*, modulat*, Mach*, Zehnder*, quantum, confin*, stark*, taper*, waveguide*, absorpt*

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2013/0071058 A1 (LIM, E et al.) March 21, 2013; abstract; figures 1a-b; paragraphs [0004, 0025, 0026, 0030, 0078]	1, 7-8, 10 --- 2-6, 9,11-20
Y	US 8,201,268 B1 (HO, S et al.) June 12, 2012; column 3, lines 42-67; column 7, lines 5-7; column 8, lines 15-17; column 11, lines 38-41	2-5, 13-20
Y	US 2012/0093455 A1 (YI, F et al.) April 19, 2012; figure 1; paragraph [0106]	6
Y	US 7,989,841 B1 (BRATKOVSKI, A et al.) August 2, 2011; figure 1; column 2, lines 30-35; column 3, lines 50-59	9, 11, 12, 16,17

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