



US006611002B2

(12) **United States Patent**
Weeks et al.

(10) **Patent No.:** US 6,611,002 B2
(45) **Date of Patent:** Aug. 26, 2003

(54) **GALLIUM NITRIDE MATERIAL DEVICES AND METHODS INCLUDING BACKSIDE VIAS**

FOREIGN PATENT DOCUMENTS

(75) Inventors: **T. Warren Weeks**, Raleigh, NC (US);
Edwin L. Piner, Cary, NC (US);
Ricardo M. Borges, Morrisville, NC (US);
Kevin J. Linthicum, Angier, NC (US)

DE	199 31 300 A1	2/2000
EP	0 740 376 A1	10/1996
EP	0 852 416 A1	7/1998
EP	0 951 055 A2	10/1999
FR	2 809 534 A	11/2001
JP	09326534 A	12/1997
JP	10135519 A *	5/1998
JP	10242584 A	9/1998
WO	WO00/33365 A1	6/2000
WO	WO01/37327 A1	5/2001
WO	WO01/43174 A2	6/2001
WO	WO01/47002 A2	6/2001
WO	WO01/59819 A1	8/2001

(73) Assignee: **Nitronex Corporation**, Raleigh, NC (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

Primary Examiner—Nathan J. Flynn
Assistant Examiner—Remmon R. Fordé
(74) *Attorney, Agent, or Firm*—Wolf, Greenfield & Sacks, P.C.

(21) Appl. No.: **09/792,414**

(22) Filed: **Feb. 23, 2001**

(57) **ABSTRACT**

(65) **Prior Publication Data**

US 2002/0117681 A1 Aug. 29, 2002

The invention includes providing gallium nitride material devices having backside vias and methods to form the devices. The devices include a gallium nitride material formed over a substrate, such as silicon. The device also may include one or more non-conducting layers between the substrate and the gallium nitride material which can aid in the deposition of the gallium nitride material. A via is provided which extends from the backside of the device through the non-conducting layer(s) to enable electrical conduction between an electrical contact deposited within the via and, for example, an electrical contact on the top side of the device. Thus, devices of the invention may be vertically conducting. Exemplary devices include laser diodes (LDs), light emitting diodes (LEDs), power rectifier diodes, FETs (e.g., HFETs), Gunn-effect diodes, and varactor diodes, among others.

(51) **Int. Cl.⁷** **H01L 33/00**

(52) **U.S. Cl.** **257/94; 257/96; 257/101; 257/103; 257/190; 257/191; 257/462; 438/173; 438/172; 438/778; 438/779**

(58) **Field of Search** **257/94, 96, 103, 257/101, 190, 191, 192, 194, 462, 347; 438/173, 172, 778, 779**

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,985,742 A * 1/1991 Pankove 357/34
5,192,987 A 3/1993 Khan et al.

(List continued on next page.)

51 Claims, 8 Drawing Sheets

