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

(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)

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

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(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**

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Primary Examiner—Nathan J. Flynn

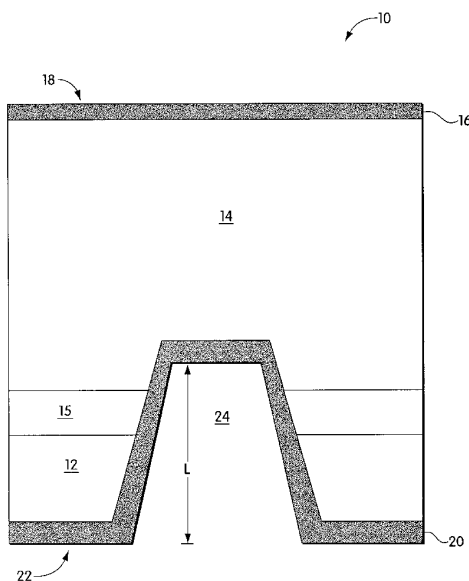
Assistant Examiner—Remmon R. Fordé

(74) *Attorney, Agent, or Firm*—Wolf, Greenfield & Sacks, P.C.

(57) **ABSTRACT**

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 topside 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 Claims, 8 Drawing Sheets



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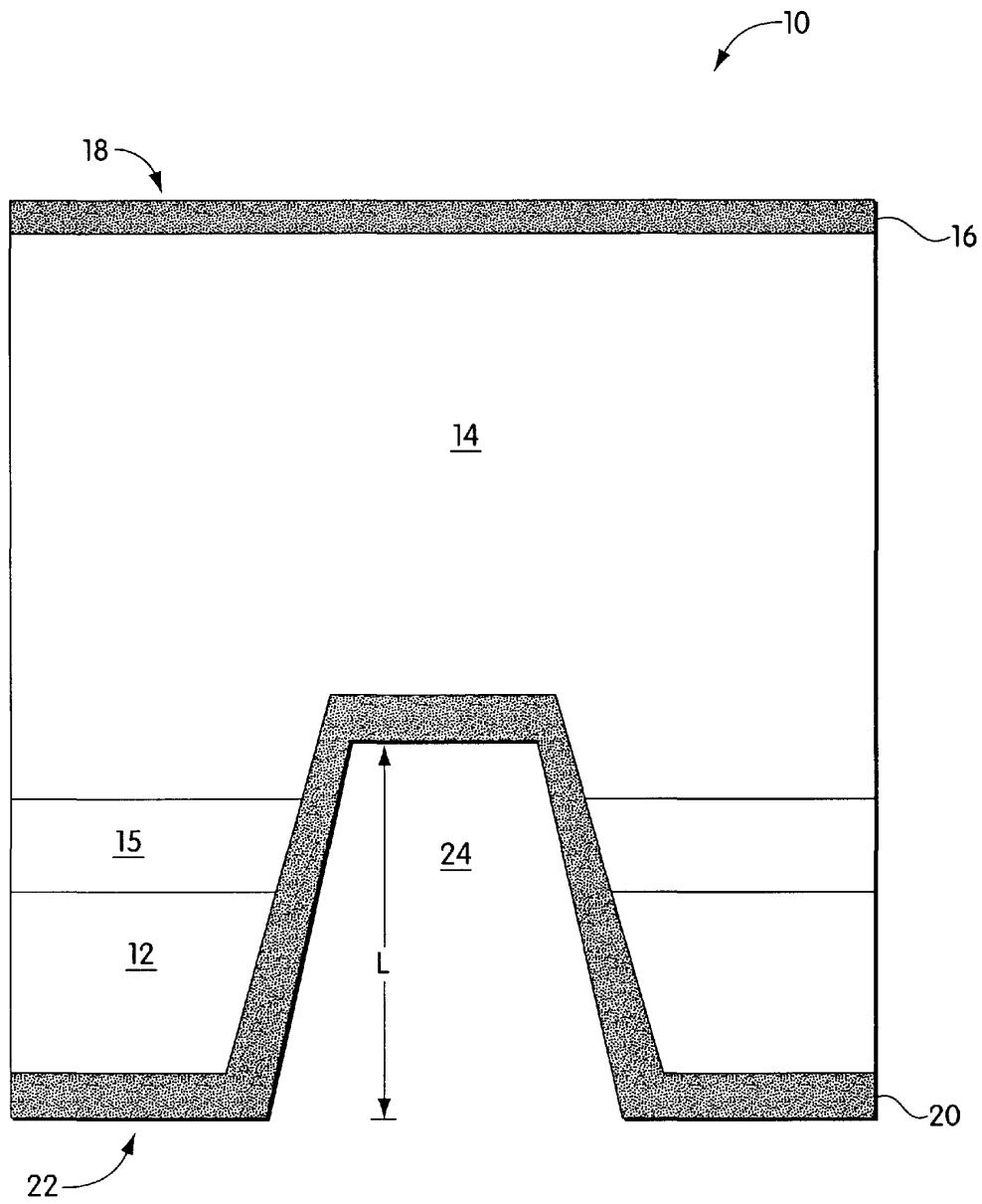


Fig. 1

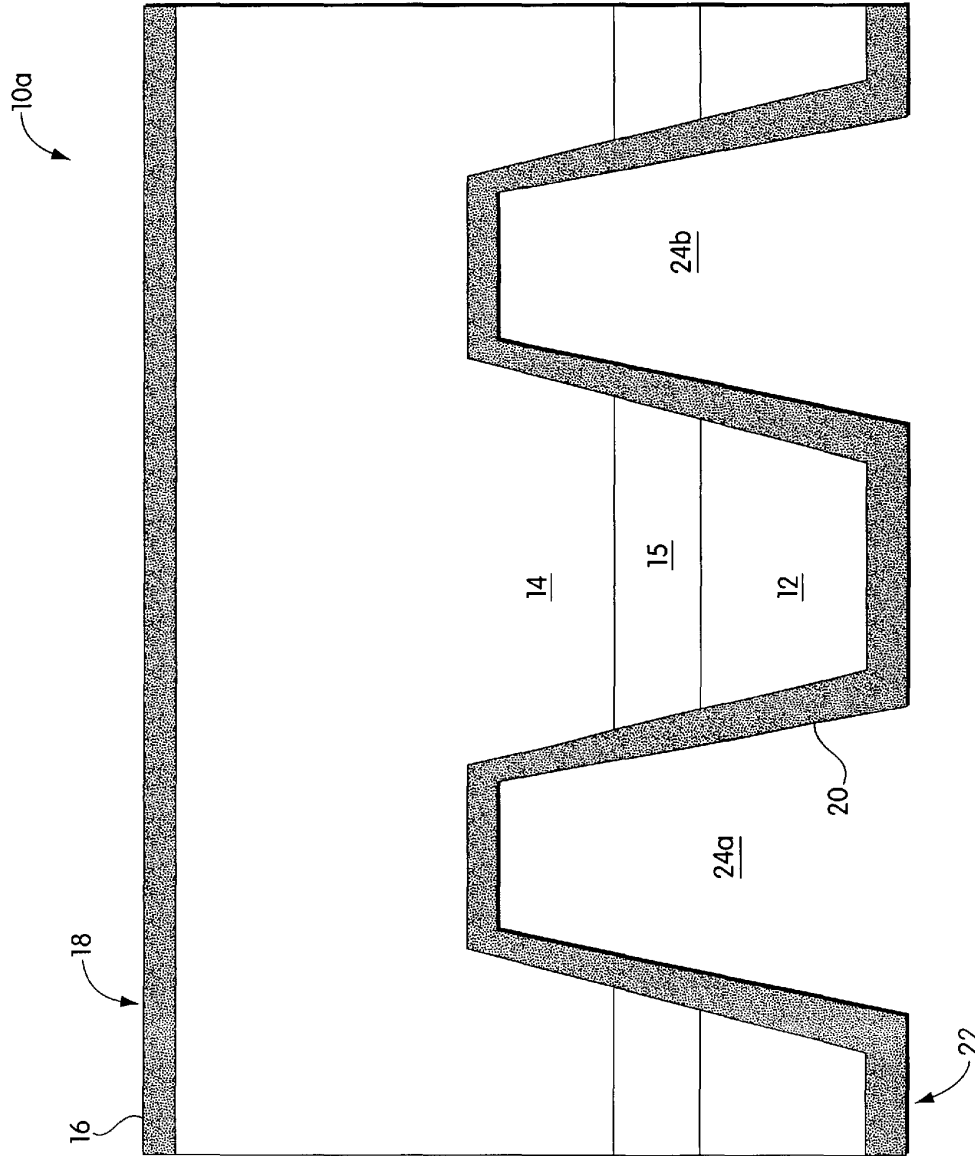


Fig. 2

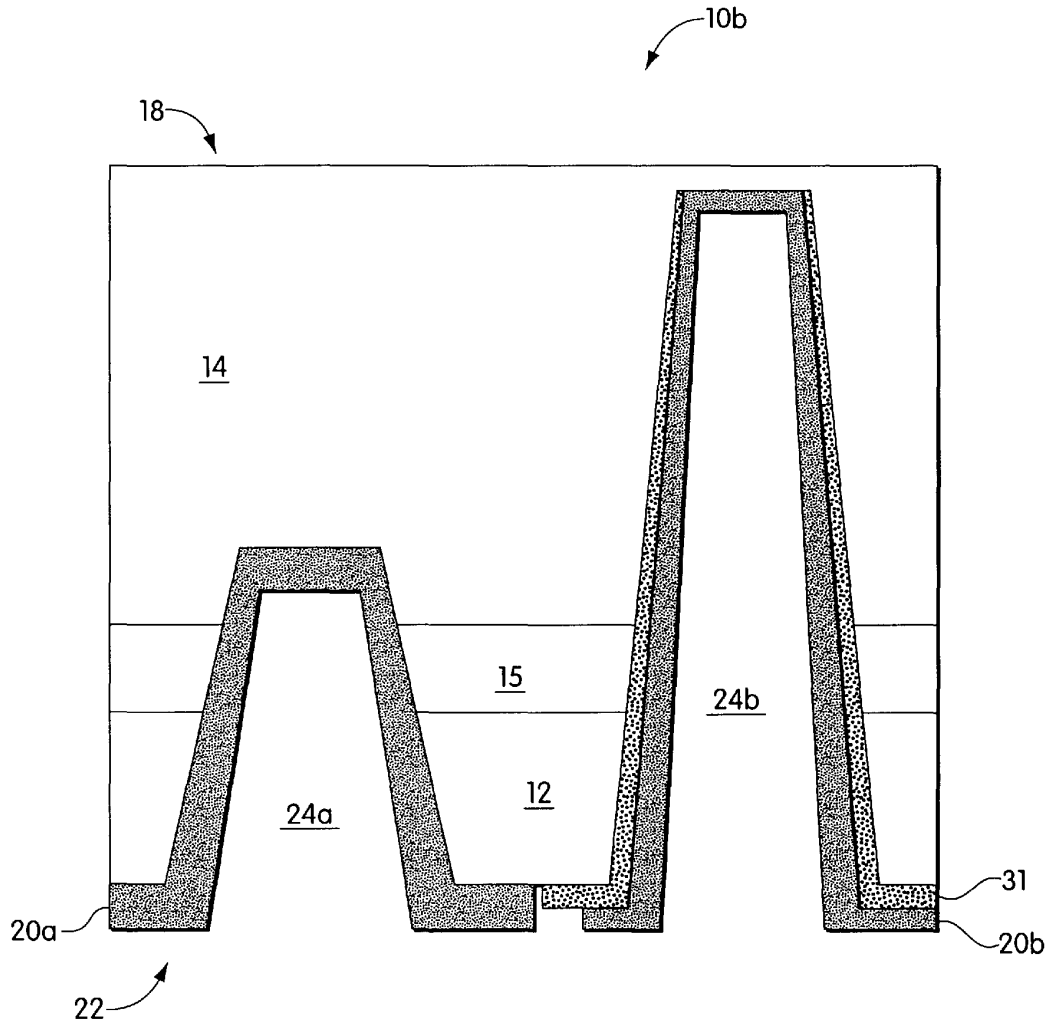


Fig. 3

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