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(54) **DIRECT DETECTOR FOR TERAHERTZ RADIATION**

(75) Inventors: **Michael C. Wanke**, Albuquerque, NM (US); **Mark Lee**, Albuquerque, NM (US); **Eric A. Shaner**, Albuquerque, NM (US); **S. James Allen**, Santa Barbara, CA (US)

(73) Assignee: **Sandia Corporation**, Albuquerque, NM (US)

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(58) **Field of Classification Search** **257/184, 257/192, 19, 187**
See application file for complete search history.

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Primary Examiner—Chuong A. Luu
(74) *Attorney, Agent, or Firm*—Kevin W. Bieg

(57) **ABSTRACT**

A direct detector for terahertz radiation comprises a grating-gated field-effect transistor with one or more quantum wells that provide a two-dimensional electron gas in the channel region. The grating gate can be a split-grating gate having at least one finger that can be individually biased. Biasing an individual finger of the split-grating gate to near pinch-off greatly increases the detector's resonant response magnitude over prior QW FET detectors while maintaining frequency selectivity. The split-grating-gated QW FET shows a tunable resonant plasmon response to FIR radiation that makes possible an electrically sweepable spectrometer-on-a-chip with no moving mechanical optical parts. Further, the narrow spectral response and signal-to-noise are adequate for use of the split-grating-gated QW FET in a passive, multispectral terahertz imaging system. The detector can be operated in a photoconductive or a photovoltaic mode. Other embodiments include uniform front and back gates to independently vary the carrier densities in the channel region, a thinned substrate to increase bolometric responsivity, and a resistive shunt to connect the fingers of the grating gate in parallel and provide a uniform gate-channel voltage along the length of the channel to increase the responsivity and improve the spectral resolution.

40 Claims, 10 Drawing Sheets

