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(54) **GALLIUM NITRIDE MATERIALS INCLUDING THERMALLY CONDUCTIVE REGIONS**

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(57) **ABSTRACT**

The invention includes providing gallium nitride materials including thermally conductive regions and methods to form such materials. The gallium nitride materials may be used to form semiconductor devices. The thermally conductive regions may include heat spreading layers and heat sinks. Heat spreading layers distribute beat generated during device operation over relatively large areas to prevent excessive localized heating. Heat sinks typically are formed at either the backside or topside of the device and facilitate heat dissipation to the environment. It may be preferable for devices to include a heat spreading layer which is connected to a heat sink at the backside of the device. A variety of semiconductor devices may utilize features of the invention including devices on silicon substrates and devices which generate large amounts of heat such as power transistors.

74 Claims, 10 Drawing Sheets