diffusivity. The use of a refractory material for the gate electrode minimizes the space required for the upper electrode system of the device, since the metal source electrode can overlie the refractory gate electrode. Additionally, by forming the gate oxide late in the process of manufacture, with minimal thermal cycling, the gate becomes relatively insensitive to radiation damage. The device, in fact, exhibits a relatively flat curve of threshold gate-to-source voltage as a function of total radiation dose up to and exceeding 1 megarad.

Although the present invention has been described in connection with a plurality of preferred embodiments thereof, many other variations and modifications will now become apparent to those skilled in the art. A non-cellular vertical conduction device can be formed rather than the multicellular device described above, for example. Also, the invention is not limited to vertical conduction devices, and applies to lateral conduction devices. It is preferred, therefore, that the present invention be limited not by the specific disclosure herein, but only by the appended claims.

What is claimed is:

1. A depletion mode power MOSFET with a refractory gate, comprising:

a base region of one conductivity type formed in a layer of semiconductor material of the opposite conductivity type by process steps including introducing dopant of the one conductivity type into an upper surface of said layer at a selected location and thermally driving said dopant to a first depth beneath the surface by maintaining said layer at a high temperature;

a source region of the opposite conductivity type formed in said base region, with an outer periphery of said source region at a surface of said layer being spaced from a periphery of said base region at said surface;

a depletion channel region of the opposite conductivity type formed at the upper surface of said base region after formation of said base region and interconnecting said peripheries of said source and base regions;

a gate oxide over said depletion channel region;

a refractory gate electrode over said gate oxide;

a dielectric layer over said gate electrode; and

a source electrode contacting said source region;

said gate oxide, said refractory gate electrode, said dielectric layer and said source electrode being formed by process steps employing temperatures lower than said high temperature used to form said base region so that the depth of said depletion channel region is minimized, wherein said depletion channel region is less than about 5,000 angstroms deep.

2. The power MOSFET of claim 1, wherein said depletion channel region contains dopant having a diffusivity less than a dopant contained in the source region.

3. The power MOSFET of claim 2, wherein said dopant of said depletion channel region is arsenic.

4. The power MOSFET of claim 1, wherein said base, source and depletion channel regions define a cell, and further comprising a plurality of further cells of same construction as said first-mentioned cell, thereby defining a multicellular device.

5. The power MOSFET of claim 1, wherein said refractory gate electrode comprises polysilicon.

6. The power MOSFET of claim 1, wherein said refractory gate electrode comprises a refractory metal.

7. The power MOSFET of claim 1, wherein said refractory gate electrode comprises a refractory silicide.

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