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Date of Application and filing Complete

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No. 5691/62

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International Classification:—H 01 g.

COMPLETE SPECIFICATION

DRAWINGS ATTACHED

Capacitor

We, TEXAS INSTRUMENTS INCORPORATED, 13500 N. Central Expressway, Dallas, Texas, United States of America, a corporation organized and existing under the laws of the State of Delaware, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a capacitor utilising a body of semiconductor material. The term "semiconductor" used herein and in claim 1 is to be construed as embracing silicon, germanium, and inter-metallic alloys such as gallium arsenide, aluminium antimonide, and indium antimonide. The capacitor may be formed either as an individual element or as an integral part of an electronic circuit formed in a single semiconductor body as described in copending parent British Patent Application No. 3633/60 (Serial No. 945,734) from which the present application is divided.

It is an object of the present invention to provide a capacitor circuit element which is small, compact, and reliable.

The present invention is a capacitor having one plate thereof comprised of semiconductor material, a dielectric layer of an oxide of silicon on said material, a layer of conductive material overlying said dielectric layer, and an ohmic contact connected to each of said semiconductor material and said conductive material.

The present invention is also a capacitor having one plate thereof comprised of silicon semiconductor material, a dielectric layer of an oxide of silicon on said material, a layer of conductive material overlying said dielectric layer and an ohmic contact connected to each of said semiconductor

material and said conductive material.

An embodiment of the invention will now be described, by way of example, with reference to Fig. 2 of the accompanying drawings, in which Fig. 1 is included for comparison purposes and illustrates a semiconductor capacitor of a construction heretofore proposed; and Fig. 2 shows a capacitor formed according to the invention.

As is shown in Fig. 1, it has heretofore been proposed that a capacitor may be obtained by utilizing the capacitance of a p-n junction. A semiconductor wafer 15 of p-type conductivity is shown having an n-type diffused layer 16, with ohmic contacts 17 made to opposite faces of the wafer 15. The capacitance of a diffused junction is given by

$$C = Ae \left(\frac{qa}{12 \epsilon V} \right)^{\frac{1}{2}}$$

where A is the area of the junction in square cm, ϵ is the dielectric constant, q is the electronic charge, a is the impurity density gradient, and V is the applied voltage.

According to the present invention, capacitance in a body of semiconductor material may be provided as shown and described in connection with Fig. 2. Fig. 2 illustrates a body 15a of semiconductor material, of either n- or p-type conductivity, which constitutes one plate of the capacitor. Evaporated onto the semiconductor body 15a is a layer 18 which provides a dielectric for the capacitor. It is necessary that the layer 18 have a suitable dielectric constant and be inert when in contact with the semiconductor body 15a. An oxide of silicon has been found to be a suitable material for dielectric layer 18 and may be applied by evaporation on thermal oxidation

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techniques onto the body 15a. Plate 19 forms the other plate of the capacitor and is provided by evaporating a layer of conductive material onto the layer 18. Gold and aluminium have been found to be satisfactory materials for the plate 19. Ohmic contact 17a is made to the body of semiconductor material 15a, while ohmic contact to plate 19 may be made by any suitable electrical contact (not shown).

Capacitors formed in the manner described in connection with Fig. 2 exhibit more stable characteristics than the type of capacitor referred to hereinbefore with reference to Fig. 1, and of course, may be fabricated as separate elements or components. Or, they may be formed in a region of a body of semiconductor material having other circuit elements or components therein or thereon so that an electrical circuit, including a capacitor, may be formed.

An advantage of the present invention is that capacitors may be fabricated more quickly and efficiently than those heretofore proposed.

Terms indicative of position, such as "on" and "overlying", are used in the following claims to define relationship of parts in a form convenient for the purpose, but such terms are not to be construed in any restrictive sense and it will be manifest that the semiconductor devices could be utilised in any desired positional orientation.

Reference is additionally made to our co-pending patent applications nos. 27542/63; 27196/63; 27195/63; 27326/63; 27197/63; 28004/63; 27198/63; 28005/63; 27540/63; 3836/63; 27541/63; and 32744/63 (serial

nos. 945746, 945740, 945739, 945743, 945741, 945747, 945742, 945748, 945744, 945738, 945745, and 945749) also divided from the parent application no. 3633/60 (Serial No. 945734).

WHAT WE CLAIM IS:—

1. A capacitor having one plate thereof comprised of semiconductor material, a dielectric layer of an oxide of silicon on said material, a layer of conductive material overlying said dielectric layer, and an ohmic contact connected to each of said semiconductor material and said conductive material.

2. A capacitor according to claim 1, wherein said semiconductor material is silicon.

3. A capacitor having one plate thereof comprised of silicon semiconductor material, a dielectric layer of an oxide of silicon on said material, a layer of conductive material overlying said dielectric layer and an ohmic contact connected to each of said semiconductor material and conductive material.

4. A capacitor according to claim 2 or 3 wherein said oxide of silicon is the oxidized outer surface of said semiconductor material.

5. A capacitor substantially as hereinbefore described with reference to Fig. 2 of the accompanying drawing.

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