April 1974

B73-10522

NASA TECH BRIEF

Langley Research Center

Silicon on Sapphire for Ion Implantation Studies

In measuring the electrical properties of silicon which has been implanted with ions that do not form junctions, it is no longer necessary to implant into a junction-isolated region to isolate the implanted layer from the bulk silicon. Epitaxially-grown, high-resistivity (greater than 100 ohm-cm) silicon on sapphire (SOS) can be used instead of bulk silicon; and, if the thickness of the epitaxial layer is comparable to the range of the implanted ions, the necessity of forming a junction-isolated region is removed. This method avoids commonly encountered problems, such as the leakage currents which alter measurements and limit the upper temperature for measurements, the compensation or interaction of the implanted atoms with the dopant atoms used to form the junction, and the addition of the processing steps required for high-quality junction isolation.

To obtain ion-implanted silicon test samples using this method, Van der Pauw or bridge samples are ultrasonically cut from, or are photolithographically etched on, SOS wafers. Contact pad regions are implanted with a moderately heavy dose of ions ($\sim 10^{15}$ cm^{-2}), of the same conduction type as the ion to be studied, which provides a low resistivity pathway between the metal contact and the region to be implanted. The ion of interest then is implanted into the sample; and, before being annealed in vacuum, the sample (excluding contact pads) is sealed with a sputtered layer of silicon dioxide, to prevent out-diffusion of the implanted species. Nickel or aluminum is sputtered or vapor deposited onto the contact pad areas and is sintered in nitrogen atmosphere. The sample then can be used for measuring properties of interest, such as resistivity and Hall voltage, over a temperature and dopant range where conduction is due primarily to the implanted atoms.

Note:

No further documentation is available. Specific questions, however, may be directed to:

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Reference: B73-10522

Patent status:

NASA has decided not to apply for a patent.

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Category 04, 01