AD-A192 700 A PLANAR IC-COMPATIBLE TRANSFERRED ELECTRON DEVICE FOR MILLIMETER-WAVE OPERATION(U) JOHANNES KEPLER UNIV LINZ (AUSTRIA) MICROELECTRONICS INST H W THIM 31 OCT 86 1/1

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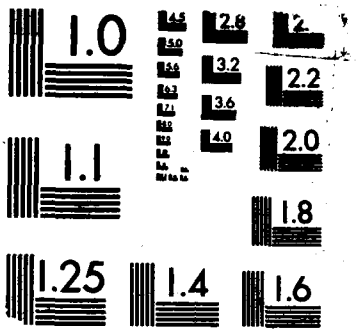

A planar IC-compatible transferred electron device for millimeter-wave operation

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One-dimensional computer simulation of the field effect controlled transferred electron device ("FECTED"); device fabrication using n-GaAs layers grown on semi-insulating substrate material by chloride VPE; developing reactive ion etching; design of microstrip circuits.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number):
During the first period of the contract a computer program has been adapted for use on an HP 9836CS desk computer. Results will be expected in November 1986. The device fabrication processes are presently being developed in order to improve yield. Reactive ion etching has been found to be of key importance for fabricating the overlapping gate cathode contact which is the key feature of the FECTED. Standard microstrip circuits have been designed and fabricated for testing the devices at Ka-band (26-40GHz). Keywords:

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The work accomplished during the first period of the contract ending Oct. 31, 1986 can be divided into three parts:

- computer simulation
- device fabrication
- circuit design

Computer simulation

A one-dimensional computer program previously used for simulating transferred electron devices with ohmic and injection limiting cathode contacts is presently modified and adapted for running on an HP 9836CS desk computer. In order to adequately simulate the inherently two-dimensional MESFET - like cathode contact of the device (a schematic view of which is shown in Fig.1) a constant cathode current is used in the one-dimensional simulation closely resembling FET behaviour. Parameters will be changed systematically in order to optimize the device. One of the most important parameters is the doping times drift length product which will be optimized initially as this parameter together with the gate controlled injected current determines the field distribution within the drift region.

The work is carried out by a student as part of his master theses.

Device Fabrication

Since no optimized design rules are yet available from the computer simulations we have designed the device according to our present understanding using computational results obtained previously by Rieder, Thim, Kuch and Lübke (AEÜ 1983, 37, 217-221). From these calculations an optimum nxL product of ($10^{16}cm^{-3}$ x 5µm) was derived for minimizing the length of the low field region at the anode contact. Previously tested devices exhibited long low field regions as the total drift length was made 10 µm and 20 µm long.

The presently fabricated devices have 5 μm long drift regions.

The first batch of devices fabricated in September exhibited short circuited gate-source regions caused by peeled-off metal contact layers as shown in Fig.2. The peeling-off occurred during a lift-off process along an insufficiently steep photoresist edge. In order to get steep edges reactive ion etching (RIE) is presently employed in the fabrication process of the second batch of devices. This work is in progress.

Circuit Design

A Test circuit has been developed in microstrip technology which allows measuring the magnitude of the reflection coefficient between 26 - 40 GHz. The two-terminal device is mounted at the end of a 50Ω line and connected to ground via a substrate hole. Both gate and drain bias voltages are fed through $\lambda/4$ sections in order to block off the RF signal. A stripline-waveguide converter is used for connecting the sweeper-circulator-detector circuit to the device. Standard numerical methodes have been used for designing the stripline parameters.

Research Plan

The work to be carried out during the remainder of the contract period is in accordance with the original plan described on page 6 of the research proposal. The official starting date of the contract is September 1st, 1986. The second interim report will be submitted on February 28, 1987.

Conferences

H.W.Thim visited several US laboratories during September 1986 including ETDL, MSC, Hughes Aircraft and NOSC and attended the 1986 GaAs Symposium held in Las Vegas.

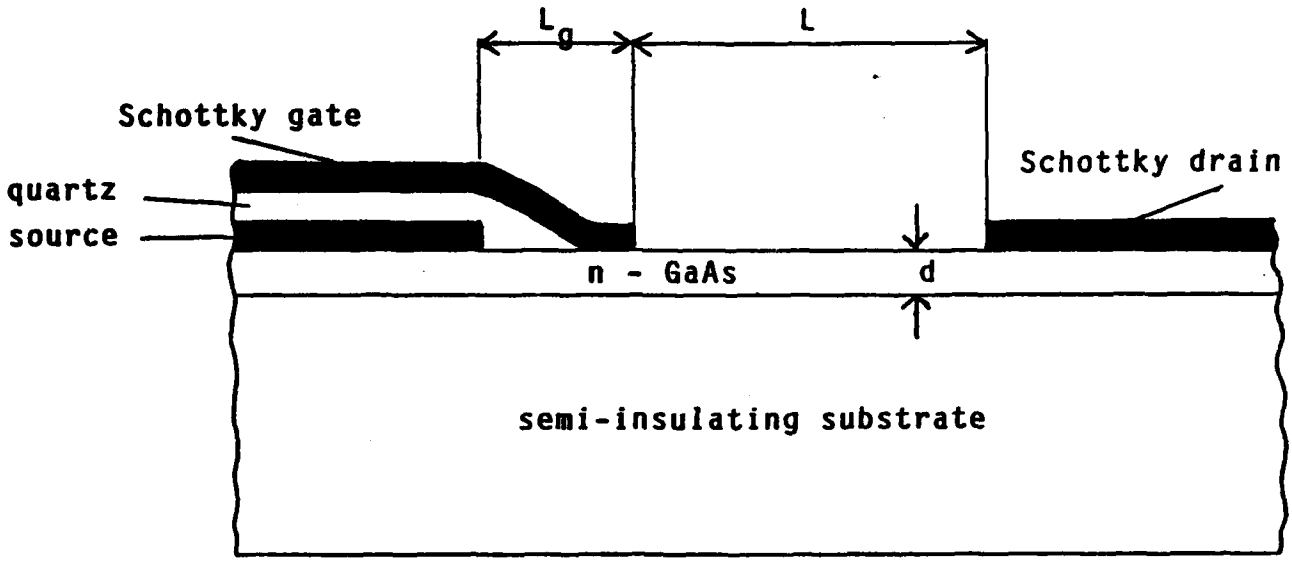

Figure 1
Cross sectional view of the FECTED

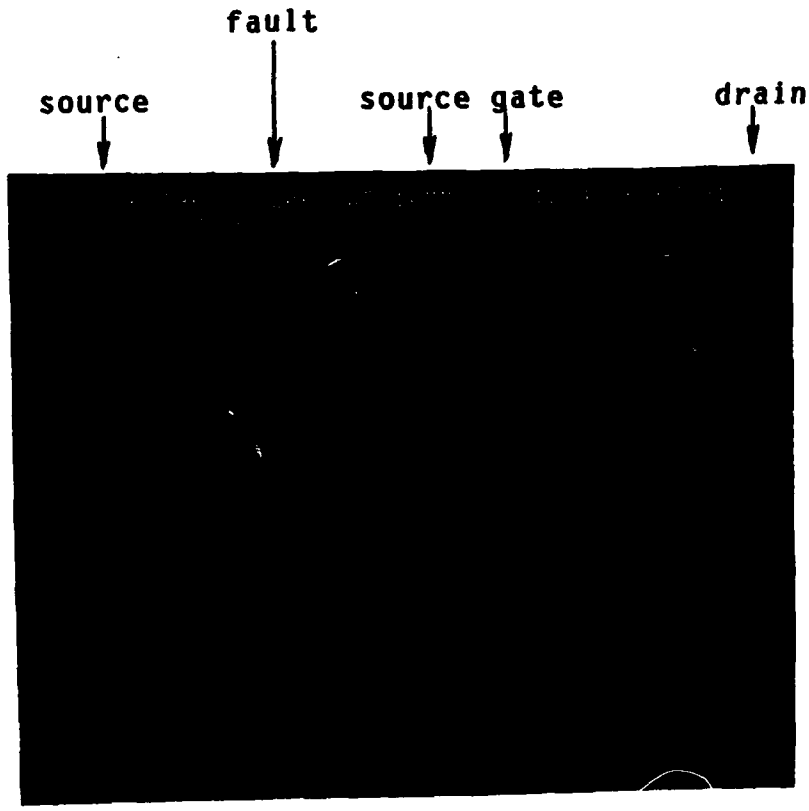

Figure 2
SEM - micrograph of the device

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