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Completely Planar GUNN-Effect Devices and Circuits

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It has been shown (SUGETA, YANAI, 1972, MAUSE, SALOW, SCHLACHETZKI, BACHEM and HEIME, 1972) that the trigger capability of planar Schottky-gate GUNN devices is (besides other factors) strongly influenced by the length of the gate electrode in the direction of current flow. Short gate lengths are desirable. So far such devices have been built in mesa technique on semiinsulating substrates in order to isolate the individual devices from each other. In integrated circuits the connections between the devices, i.e. between the cathode of the first device and the Schottky gate of the following device(s) are applied to the semiinsulating substrate after etching the mesas. Upon the mesa slope the length of the gate connections increases and hence decreases the trigger capability. (c.f. Fig.1)
It is shown that the connections between the GUNN devices may be well applied to the conducting GaAs layer without loss of response speed of the circuit. It is only necessary to remove all of the conducting epitaxial GaAs outside the active volume and outside the metal connections. This can be done either by ion (proton) implantation or by ion etching. In this work DC ion etching was used. Material not to be removed was covered by photo resist. The advantages of this new method will be discussed. Experimental results on individual devices as well as on integrated circuits will be shown. The integrated circuits consist of four Schottky-gate GUNN devices with the gates either in series or in parallel. In addition to the advantages of the new method in the trigger capability the simultaneous use of ion etching and ion sputtering enables the production of integrated circuits on GaAs without any wet chemical process and the use of refractory metals, especially for the gate contacts.

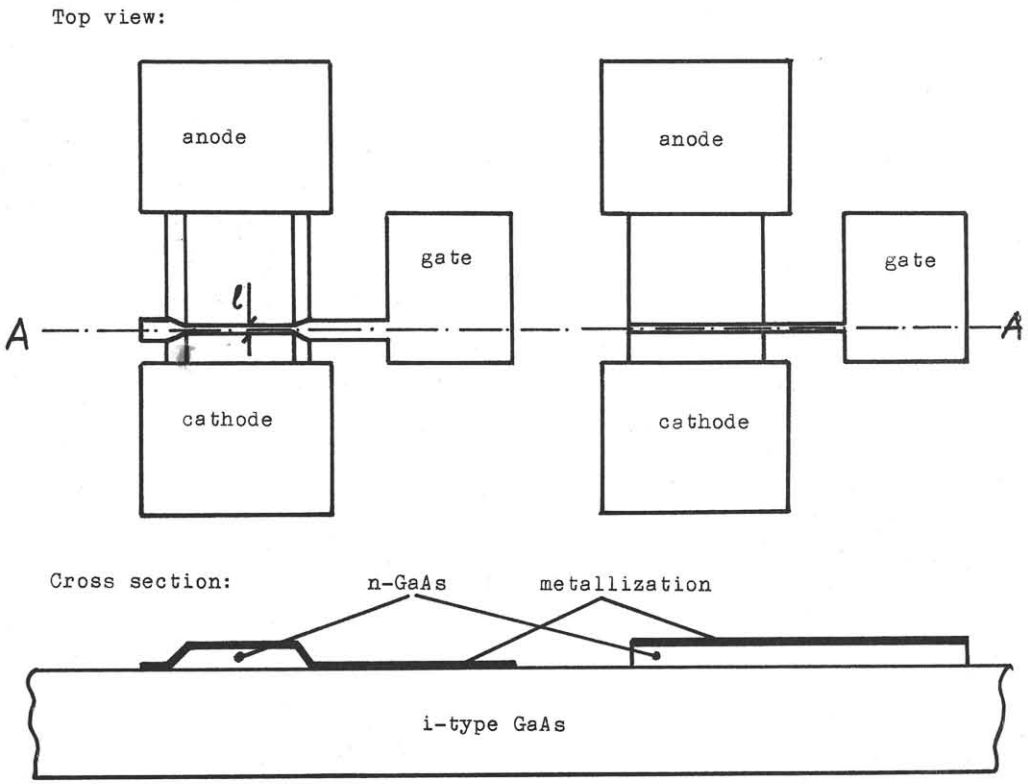

Fig. 1 : Top view and cross section of Schottky-gate GUNN devices

a) Mesa type device. Due to the effect of defocussing during the exposure of the photo resist the length l of the gate increases upon the mesa slope

b) In a completely planar device no such effect exists