Letters

A new mesa-etching technique for gallium arsenide

Gallium arsenide is now widely used to make microwave devices like Gunn diode, avalanche diode etc. A mesa configuration is very often used in many of the devices so that the device can be bonded face down to the heat sink to facilitate efficient heat transfer from the active region. To avoid problems associated with the formation of undesirable Schottky barriers arising from any contact between the bulk semiconductor and the heat sink, a deep mesa is desirable. With most of the conventional etchants, however, there is usually considerable under-cutting of the mesa which results in a deterioration of the device. A potassium cyanide, water and peroxide etch [1] has recently been proposed which gives good preferential etching. We have, however, found that this gives rather a rough surface and does not avoid undercutting for such deep mesas. We have discovered that the surface photovoltaic effect can be very suitably used for obtaining preferential etching in gallium arsenide. It is well known [2] that the etching rate of a semiconductor in an electrolytic solution can be considerably enhanced by shining light on the semiconductor-electrolyte interface. Thus if one has illuminated and dark regions on a semiconductor surface put in an electrolytic solution, the etching rate would be much larger in the illuminated areas. This property has been made use of in the fabrication of Gunn diodes. An array of circular metal contacts was deposited on an n on n^+ GaAs wafer by evaporating Au-Ge-Ni [3] through a metal mask. The contacts were next alloyed at 450° C in a hydrogen atmosphere. The wafer was then placed in a 10 H_2SO_4:1 H_2O_2 : 1 H_2O solution on which light from a tungsten filament lamp was incident. The metal dots protected the area underneath from illumination. The area uncovered was therefore etched without any undercutting giving rise to beautiful mesa-structures. A typical sample is potted in a transparent resin and Fig. 1 shows the photograph of the section of two mesa-structures taken in transmitted light. One can note the absence of undercutting at the edges of the mesas. Diodes are now being made routinely using this technique dissipating typically 10 W of power without any degradation of the device. This technique can also be suitably used for making mesa on other devices.

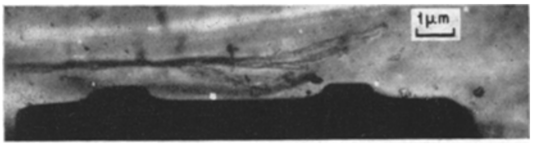

Figure 1 Transmitted light photograph of the section of a typical etched sample showing two mesas. Note the outward slope of the edge of the mesas.

References

1. C. A. MILLER and J. B. SHUTTLEWORTH, *J. Mater. Sci.* **6** (1971) 1231.
2. R. W. HAISTY, *J. Electrochem. Soc.* **108** (1961) 790.
3. N. BRASLAU, J. B. GUNN, and J. L. STAPLES, *Solid State Electronics* **10** (1967) 381.

Received 17 October 1972
and accepted 5 January 1973

B. M. ARORA
V. T. KARULKAR
S. GUHA
Tata Institute of Fundamental Research,
Bombay 5, India

Stress relaxation in superplastic materials

The stress relaxation technique has been extensively utilized in the recent past to study the plastic flow in crystalline solids [1-9]. In this method, a specimen is deformed, at a given temperature, to some stress level. The machine crosshead is then arrested and subsequent load drop, which occurs by the plastic flow of the specimen relieving elastic strain of specimen and machine, is recorded as a function of time. From the analysis of load relaxation curves, it is possible to determine the dislocation velocity – stress exponent, thermal and athermal components of flow stress and various thermodynamic parameters associated with plastic deformation such as activation energy and activation volume.