been possible. Thanks are also due to Dr. G. L. J. Bailey and Mr. A. R. Heath, of the British Non-Ferrous Metals Research Association, London, for their co-operation and assistance.

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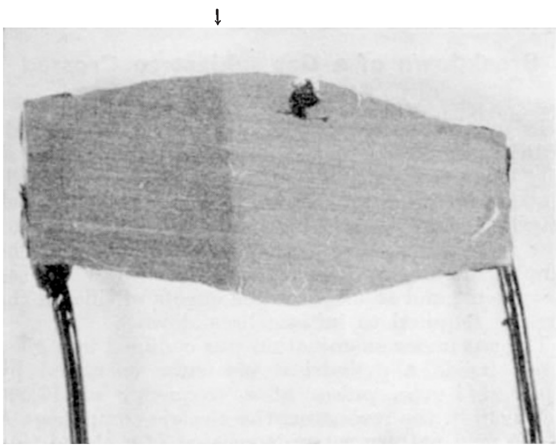
p-n Junction revealed by Electrolytic Etching

In the preparation and application of *p-n* junctions in germanium and similar materials, it is often important to locate the potential barrier precisely in order to attach electrodes or probes near by. Such a barrier is, in general, not visible, as the crystalline structure of the material on either side of it is identical, that is, a single crystal of germanium of high purity and with a high degree of perfection throughout. The fact that one part (the *n*-type region) conducts by electrons in the conduction band and the other (the *p*-type) in the valency band, that is, by 'holes', cannot be shown up by any of the standard metallographic techniques. The usual method of locating the barrier, namely, by electrical probing along the surface, is not very satisfactory.

However, the boundary can be shown up by using a method that depends on the rectifying behaviour of such a junction. The specimen is immersed in a suitable electrolyte, and electrical current is forced through it in such a way that only the *n*-region is anodically attacked, that is, the positive terminal of a battery is connected to the *n*-part of the specimen and the negative to an inert electrode, such as graphite, nickel, stainless steel, etc., serving as the cathode. Regarded as a rectifier, the junction is then biased in the blocking direction. The current flowing into the specimen cannot cross the barrier but passes into the electrolyte instead, and from there to the cathode. The *n*-type part of the specimen is therefore etched anodically, while the *p*-type part of the sample, passing practically no current, is scarcely attacked.

In some preliminary experiments, 10 per cent potassium hydroxide aqueous solution was used as the electrolyte, at a temperature of about 25° C. The best results were obtained with the specimen ground in the usual way, without any prior etching being applied. A current density of about 1 m.amp./mm.^{2} was maintained for 1–2 min. and was found to give quite distinct etching, as shown in the photograph.



p–n Junction (marked by arrow) in germanium

Various alternatives of the method can be used. Instead of using an independent (inert) cathode, the D.C. supply voltage may be applied directly across the two ends of the specimen, the anode to the *n*-part as before and the cathode to the *p*-part. Current passing into the *n*-part from the anode again cannot cross the junction barrier, but instead passes into the electrolyte and thence into the *p*-part of the specimen. There is practically no effect on that part of the germanium specimen acting as the cathode, while the *n*-part will be etched anodically as before. The leads connecting the specimen to the voltage supply should be insulated to avoid corrosion.

In a similar way, an *n-p-n* specimen can be made to show up the *p*-region; if connected with the two *n*-parts joined in parallel, these will be etched anodically, while the *p*-part will remain unaffected, practically no current passing through its surface; the cathode in this case should be a neutral material, for example, graphite.

It was noted that the electrolytic type of etching, while rendering the *p-n* boundary readily visible, is much less effective than certain chemical etches are in improving the rectifying characteristics of a junction. This is presumably because only a strong chemical etch will strip the junction completely of any contaminated surface layer which might otherwise act as a partial short-circuit in parallel with the high electrical resistance of the barrier. Electrolytic etching as described will only clear the *n*-part of the junction; if the *p*-part were used as cathode, electrolytic etching might make matters worse by cathodic deposition on the *p*-region close to the junction. The following rectification ratios were obtained on a particular junction after various treatments.

Treatment of junction	Surface ground	Electrolytic etch (*p*-part as cathode)	Electrolytic etch (independent cathode)	Chemical etch *C.P.*4
Rectification ratio	1 : 2	1 : 2·8	1 : 45	1 : 10,000

We wish to express our gratitude to E. W. R. Francis, who carried out most of the experimental work.

Since starting these experiments, it has come to our notice that similar techniques are being developed elsewhere in Britain and the United States.

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Travelling Disturbances in the Ionosphere

Measurements of the horizontal velocity of travelling disturbances in the *F*2 region of the ionosphere have been made in this department over the past three years, using the method described by Munro[1]. Constant-frequency pulse transmitters were set up at the base station in the Physics Department of the University of Western Australia, and at two other stations situated respectively 15 miles east and 25 miles south-east. The two remote stations were triggered, after a short adjustable delay, by the