LETTERS TO THE EDITORS

PHYSICS

Effect of Hydrogen-Ion Bombardment on the Oxides of Aluminium and Magnesium

COMMERCIAL high-purity, polycrystalline samples of aluminium oxide and magnesium oxide have been subjected to bombardment by a 300- μ amp. beam of hydrogen ions having an energy distribution with a maximum at 500 eV. At this energy, the maximum penetration into the substances would be of the order of 100 Å., and therefore any changes of property observed would, in the main, be confined to these regions. Changes in electrical resistance have been

Fig. 1. Variation of resistance with bombardment time of: O, magnesia; Δ , alumina

Fig. 2. Recovery of electrical resistance subsequent to bombardment, as a function of $t^{1/2}$ (sec.) for MgO. A, Bombarded for 150 sec.; B, bombarded for 240 sec.; C, bombarded for 300 sec.

recorded as a convenient means of following the effect of the bombardment.

Fig. 1 illustrates the variation of resistance with time of bombardment, and, as can be seen, there is no sign of the observed effect becoming saturated within the time-scale used. Subsequent to bombardment, it was found that the electrical resistance recovered to its original value; this is shown in Fig. 2 for the case of magnesium oxide. Aluminium oxide exhibited a similar behaviour. The full recovery process took place at room temperature, suggesting an activation energy of about 0.1 eV. In addition, the strong dependence of the recovery process on $\sqrt{t}$ (where t is time) is suggestive of a diffusion mechanism. However, further work is required before a full understanding of this effect, which may conceivably have important practical implications, is obtained.

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Submillimetre Waves by Harmonic Generation from Cold Cathode Arcs

THE use of the mercury pool arc for microwave harmonic generation has already been described^{1,2}. The purpose of this communication is to report some preliminary results obtained with solid cathodes.

As before, the driving power used was a few watts obtained from a continuous-wave Q-band klystron operating at 35 Gc./s. The arc was mounted in a Q-band wave-guide and was so oriented that the $\frac{1}{2}$ -mm. diameter tungsten-wire anode was parallel to the microwave electric vector. The cathode material in the form of a thin slab was mounted adjustably through the H-plane wall of the wave-guide beneath the wire anode. The arc was struck by applying d.c. to the anode (via a variable resistance) and then moving the cathode until contact was made between it and the pointed end of the anode. The cathode was then withdrawn so that an arc less than 0.1 mm. in length was formed. Harmonic output was collected by means of a smaller wave-guide protruding through an E-plane wall of the Q-band wave-guide close to the arc. No effort was made to match the arc to the output wave-guide.

At high gas pressures (for example, 20 atmospheres argon) disintegration of the cathode material under the action of the cathode spot is much reduced; the cathode spot is clearly emitting at a very high current density, yet the cathode remains 'cold'. It seems that, in principle, any conductor may be used for harmonic generation, but for most materials the cathode spot wanders from beneath the anode wire, thus lengthening the arc and producing a startling drop in harmonic output. Calcium is the most successful cathode tried to date, but even with this material a small movement of the spot can be seen