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THE EFFECT OF HYDROGEN-SULPHIDE ON THE UNILATERAL CONDUCTIVITY OF ZINCITE-COPPER CONTACTS.

R. B. DODSON.

Of the many experiments concerned with the unilateral conductivity of the so-called crystal rectifiers very few have had to do with the effect of gases.

The experiments described in this paper show that an artificial rectifier can be produced through the action of hydrogen-sulphide upon zincite-copper contacts. Such contacts show little or no unilateral conductivity in vacuo but possess the property to a considerable degree in an atmosphere of hydrogen-sulphide.

In air the behavior of such contacts is extremely erratic. The greater current is as likely to pass from zincite to copper as from copper to zincite. Often there is no difference between the two currents. Sometimes the greater current may flow from copper to zincite for a few days and at the end of a week the greater current may pass from zincite to copper.

The zincite and copper were placed in a glass tube with suitable electrical connections and the tube evacuated with a Gaede mercury pump to as low a pressure as could be obtained without freezing mixtures. A piece was then broken off the zincite and the end knocked off the copper point. The two freshly made surfaces were then brought together and a direct electromotive force impressed on the contact for fifteen or twenty minutes in one direction and then in the other. Readings were taken at the end of every minute and curves plotted from the points so obtained. In order to economize space the curves are plotted with the same origin instead of consecutively with respect to the time.

Curves No. 1, figure 41, show the flow of current shortly after the two substances were brought into contact in air. It will be noted that the greater current flows from copper to zincite. After a few days the amount of rectification began to fall off and at the end of three days the situation was as shown in No. 2. Curves No. 3 show the same contact at the end of a week. There is now

about one milliamperere difference between the two currents with the slightly greater current flowing from zincite to copper. Curves No. 4 show the behavior of the same contact when reversals of the electromotive force are made at the end of every minute. The general effect of the quick reversals is to lessen the difference between the two currents.

Curves No. 5, figure 42, show a zincite-copper contact in vacuo. In this particular case there is a difference of about two milliamperes between the two currents with the greater current flow-

FIGURE 41

ing from zincite to copper. Usually the difference between the two currents was less than a milliamperere in vacuo.

Immediately after letting in the hydrogen-sulphide there was an increase in the apparent resistance of the contact, causing the current to fall from seventy-four milliamperes, zincite to copper, to sixty-nine milliamperes, zincite to copper. This effect is characteristic of hydrogen-sulphide and never failed to appear whenever the gas was let into the vacuum tube. Curves No. 6 show the action of the contact shortly after letting in the hydrogen-sulphide. The difference between the two currents is now about five milliamperes with the greater current from zincite-

to copper. The observations for curves No. 7 were taken two days after the previous curves. The difference is now about seven milliamperes. The observations for No. 8 were taken about ten days after No. 6 and show a difference of about seven milliamperes.

These curves are typical of the behavior of zincite-copper contacts. Of the several contacts studied none departed from the results shown here to any extent.

The behavior of zincite-copper contacts in vacuo and in hydrogen-sulphide has a bearing on the theories of rectifier ac-

FIGURE 42

tion. It is direct evidence that unilateral conductivity is entirely a surface phenomenon so far as the so-called crystal rectifiers are concerned.

There is considerable indirect evidence favoring a surface film theory of rectifier action. Unilateral conductivity is certainly not a volume effect for small thin pieces of crystal possess the property to as high a degree as large thick pieces. Again almost the entire resistance of the contact is concentrated at the surfaces as is shown by the fall of potential across the contact. The fact that not all points on a given crystal surface possess the

property of unilateral conductivity to the same degree is also significant.

Mr. Goddard¹ working with Tellurium-Aluminum contacts in vacuo, and in oxygen and air finds that such contacts possess unilateral conductivity in air and oxygen but not in vacuo. Mr. Goddard's work and the behavior of zincite-copper contacts in vacuo and in hydrogen-sulphide constitute direct evidence that unilateral conductivity is a surface effect and that surface films of some sort are the seat of the action.

It is possible that there are other gases capable of producing the same effect under proper conditions; some of the halogens for instance. However, no such compounds possessing rectifying properties, have been found in nature.

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¹Physical Review, Vol. 34, p. 449.