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Dieterich: Notes on the Construction of Selenium Bridges

NOTES ON THE CONSTRUCTION OF SELENIUM BRIDGES.

E. O. DIETERICH.

The value or effectiveness of a selenium bridge depends upon several factors; namely:

1. The resistance of the bridge.
2. Its permanence, or stability.
3. Its sensitiveness, i. e., the ratio of the resistance of the bridge in the dark to that in the light.
4. The shape of the wave-length-sensibility curve.

This paper summarizes the results of an investigation of the conditions governing the production of selenium bridges of certain types.

In this investigation bridges of the Bidwell type were constructed; that is, two parallel wires were wound spirally around an insulating form, and the spaces between the wires were filled with selenium. In applying the selenium to the form the following method was adopted. The form was first heated to a temperature slightly above that of the melting point of selenium, 217°C., and then the selenium, in stick form, was rubbed over the heated surface. In this way, a thin, uniform layer of selenium was obtained which crystallized immediately, on cooling, to the gray metallic variety, which is conducting and light-sensitive. However, in these experiments, the resistance was, in general, very high, and the sensitiveness low. The samples were, therefore, subjected to an annealing process; i. e., they were kept in an electric oven at a high temperature for some hours. After annealing each sample was immediately transferred to a glass tube which had been carefully dried and which was then securely sealed to prevent the access of moisture and vapors. With these precautions all of the samples were found to be permanent, with respect to light sensitiveness, at least throughout the duration of this investigation, and very steady.

To analyze the bridges the same method of procedure was followed as that described by Doctors Brown and Sieg[1], and the same apparatus was used. The analysis revealed several new types of wave-length-sensibility curves. It was found that some bridges, instead of showing a maximum sensitiveness to red light, were most sensitive to blue light. In general, two types of curves resulted; those that showed a maximum at wave lengths shorter than 640$\mu\mu$, and those that had a maximum at

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wave lengths greater than 640$\mu\mu$. Those which showed a maximum above 640$\mu\mu$ had a pronounced minimum at 640$\mu\mu$, a broad maximum at the shorter wave lengths, and a sharp maximum at either 700$\mu\mu$, or 720$\mu\mu$. Maxima were found at the following wave lengths in various samples: 440$\mu\mu$, 500$\mu\mu$, 550$\mu\mu$, 700$\mu\mu$, 720$\mu\mu$, and 800$\mu\mu$. The location of the maximum was found to be dependent upon the method of annealing; those samples annealed at temperatures above 190°C. had a maximum in the blue, while those annealed at temperatures below 190°C. showed a maximum in the red.

The resistance of the bridges, also, was found to vary with the procedure adopted in annealing, in a manner previously described by Ries[2], who, however, gave this phase of the subject but a very brief consideration. With very few exceptions, the samples annealed at a temperature near the melting point of selenium had a low resistance. Some of those that were annealed at 180°C. or 190°C. were given a short preliminary heating at 210-215°C. It was found that those so treated also had a low resistance, while others made at the same time but not given this preliminary heat treatment had a resistance much higher, in some cases, ten to fifteen times as great.

With regard to the conditions governing the sensitiveness of the bridges much cannot be said at this time, except that the sensitiveness also seems to be dependent solely upon the method of annealing. Two samples, much more sensitive than the rest resulted, and, as far as is known to the author, the only difference in making was in the temperature control during the annealing process. These samples, however, did not retain their high sensitiveness, nor has it been possible to duplicate them.

A more complete discussion of the results of this investigation is in preparation, and is soon to be published in the Physical Review.

The writer wishes to acknowledge his indebtedness to Doctor Brown and to Doctor Sieg for the use of their apparatus and for their many helpful suggestions.

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