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DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
WASHINGTON

Letter
Circular
L C 199



May 19, 1926.

SELENIUM CELLS; PHOTOELECTRIC CELLS; THERMOPILES

1. This communication is sent in response to your inquiry concerning light-reactive cells.

2. SELENIUM CELLS: Information on the design, construction and characteristics of selenium cells may be found in a book on "Selenium Cells, (How Made)", by Thomas W. Benson, (published by Spon and Chamberlain, 120 Liberty Street, New York, N. Y.); also in a book on Selenium Cells and How They are Made by Samuel Wein (Spon and Chamberlain, New York); and in Bureau of Standards Scientific Paper No. 319, which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a cost of ten cents per copy. See also summary on Selenium Cells in a book on Primary Batteries by W. R. Cooper, (D. Van Nostrand Company, New York, N. Y.)

3. At this writing, selenium cells may be purchased from the following dealers: The Braun Corporation, Los Angeles, California; The Photoelectric Bean-Grader Company, Inc., Ithaca, Michigan; John J. Griffin and Sons, Ltd., London, England; James Biddle, Philadelphia, Pennsylvania; The Electro Importing Company, New York, N. Y.; Richardson, Cook and Seixas, 154 Nassau street, New York, N. Y.; and L. E. Knott Apparatus Company, Cambridge, Mass.

4. The element, Selenium, may be purchased from dealers in chemical supplies, e.g., Eimer and Amend, New York, N. Y.; or B. F. Drakenfeld and Company, Inc., 50 Murray street, New York, N. Y.

5. The electrical properties of a selenium cell depend so much upon heat treatment, that specific statements cannot be made. Its sensitivity is a function of many factors; for example, temperature, also the intensity and the color of the light.

6. In the dark, the resistance of a selenium cell increases with decrease in temperature. Records show that a selenium cell having a dark resistance of 1,000,000 ohms at 20° C, (68° F) increased to three times that value (3,000,000 ohms) at 0° C, (32° F).

7. When exposed to light, the resistance of a good cell drops as low as 1/10 to 1/50 of its value when in the dark; but this change in resistance is a function of the spectral quality (the color) and the intensity of the light; also the temperature of the cell. At low temperatures (0° C) the intrinsic photoelectrical sensitivity of the selenium cell is far greater than at 30° C.

8. Selenium cells usually have a dark resistance of 100,000 to 500,000 ohms. When exposed to full daylight, the resistance may be reduced to between 3,000 to 10,000 ohms. The resistance change of the selenium cell on exposure to light, and its recovery after exposure is not instantaneous, especially when exposed to light of long wavelengths.

9. In Bureau of Standa rds Scientific Papers No. 319, p. 527, reference is cited showing that the spectral light sensitivity curve of a selenium cell depends upon heat treatment. A cell that has been annealed at 200° C, has its maximum sensitivity in the red part of the spectrum, while a cell which has been annealed at 150° C, has its maximum sensitivity in the blue-green part of the spectrum.

10. Since the magnitude and the position of the spectral maximum of sensitivity of a selenium cell depends so largely upon heat treatment (as well as upon temperature and perhaps humidity) we do not regard it a suitable device for standa rdization.

11. PHOTOELECTRIC CELLS: The above mentioned selenium cells, (solid electrical conductors) function as a result of a change in their electrical conductivity when exposed to light. The gas-ionic photoelectric cell functions as a result of a change in the electrical conductivity of the gas intervening between the positive electrode (usually a fine wire) and the negative electrode (consisting of a relatively large surface of some metal, for example, potassium, barium, etc.) which is exposed to light.

12. The gasionic photoelectric cell is practically instantaneous in its action and is not greatly affected by temperature. Some of the highly evacuated types (also some cells filled with inert gas) have a fairly close linear relationship between the current and the intensity of the illumination. When subjected to continuous usage they are likely to become fatigued and the sensitive surface may be destroyed. (Further data are given in Bureau of Standards Scientific Papers No. 319, obtainable from the Superintendent of Documents, Government Printing Office at a price of ten cents per copy.

13. Photoelectric cells of the gasionic type, made of potassium, barium, etc., may be purchased from the following dealers: The Case Research Laboratory (which makes also the Thalofide Cell and photoelectric properties mentioned in Bureau of Standards Scientific Paper No. 380, obtainable from the Superintendent of Documents at a price of five cents per copy), Auburn, New York; The G-M Scientific Instrument Company, Urbana, Illinois; The General Research Laboratories, 326 River Street, Chicago, Illinois; and the General Electric Company, Schenectady, New York.

14. THERMOPILES: The method of construction and properties of thermopiles is given in Bureau of Standards Scientific Papers No. 229, obtainable from the Superintendent of Documents, at a price of 20 cents per copy. Thermopiles of this type are obtainable from The Eppley Laboratory, Newport, Rhode Island.

15. New types and new designs of the above described types of radiometric instruments are frequently to be found in the literature and the advertisements in "The Physical Review" also in the "Journal of the Optical Society of America and Review of Scientific Instruments".