"THALOFIDE CELL" — A NEW PHOTO-ELECTRIC SUBSTANCE.

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Synopsis.

A new photo-electric cell is described which is composed of thallium, oxygen and sulphur. This cell shows maximum sensitiveness to light of wave-length about 10000 Angstrom units. Some of the best cells lower their dark resistance by fifty per cent. in .06 foot candles when the light source is a tungsten filament. The dark resistance of different cells may be from 5 megohms to 500 megohms. The induction and deduction periods of the cells are very small. The chief characteristics of the cell are mentioned.

In the April issue of the Physical Review, 1917, the author published a list of substances which were examined for change of resistance under the influence of light. This work was continued, although no substance at that time had been found which compared in sensitivity with selenium. Most of the new combinations found, however, indicated that sulphides would be the most promising field for future work.

On October 2, 1917, the author found that thallium sulphide (fused) showed a slight change of resistance under the influence of light.

After two years of research upon this compound, very sensitive cells have been made to which the name "Thalofide Cell" has been given, indicating that the present sensitive substance is composed of thallium, oxygen and sulphur. The thalofide material after careful preparation is first fused on a $\frac{3}{4}''$ quartz disc and then it is placed in an evacuated tube. The effect of the vacuum is to increase the sensitivity of the element from three to five times and also preserve its life by preventing oxidation. Several hundred of these cells are now over a year old and have not lost any of their initial sensitiveness.

As no quartz spectrometer was available at the beginning of this work, the spectral sensitivity was roughly determined by means of combinations of Wratten filters; and the maximum sensitiveness was found to be somewhere between 8,000 Å.U. and 15,000 Å.U. Since that time, Dr. W. W. Coblentz of the Bureau of Standards has accurately determined the maximum point at 10,000 Å.U. The spectral sensitivity curve of this cell in a red glass bulb is reproduced in Fig. 1.

By means of the same Wratten filters, it was found that the blue and violet rays had a deleterious effect on the element in that after rather strong exposure, the resistance was somewhat permanently lowered by this upper part of the spectrum, and the recovery period after exposure was much slower. This was prevented by the use of

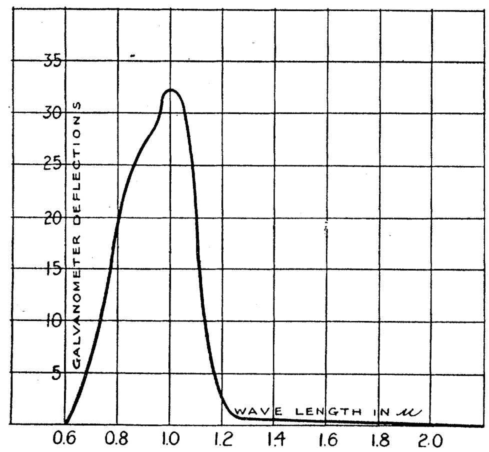

Fig. 1.

flashed copper ruby glass for the material of the vacuum bulb. The cells can then be exposed to much stronger radiation without harm, and it was also found that the recovery period was extremely fast, which is in marked contrast to selenium. The average sensitivity of these cells

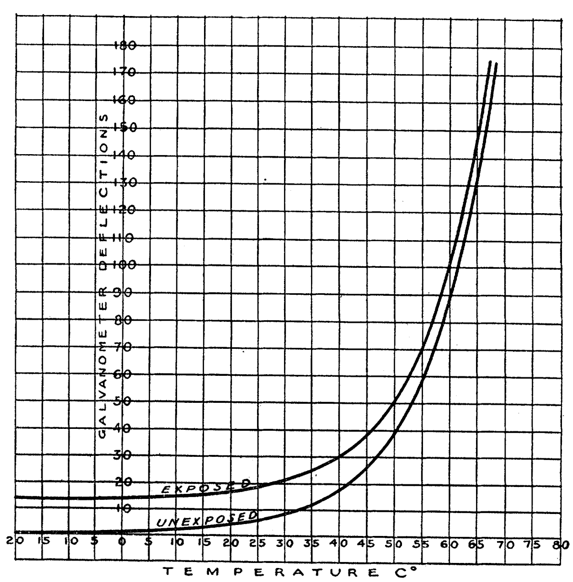

Fig. 2.

is such that their dark resistance is lowered by fifty per cent. in 0.25 foot candles when the source is a tungsten filament. Some of the best ones however, will lower their dark resistance by fifty per cent. in 0.06 foot candles.

These cells have been designed so that a large per cent. action is obtained between dark resistance and resistance on exposure, consequently their dark resistance is high as compared to the ordinary selenium cell. The resistance in the dark of different cells may range from 5 megohms to 500 megohms.

The dark resistance varies inversely with the temperature. A char-

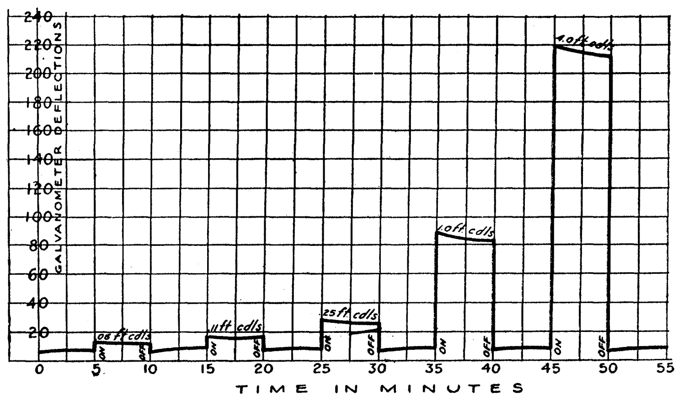

Fig. 3.

acteristic temperature curve together with light action of a cell on a fixed potential is shown in Fig. 2.

As a general rule, not over 50 volts should be used on these cells. On applying the potential, the resistance will be gradually lowered but an equibrium is soon reached. On exposure to light, the resistance is immediately lowered and upon cutting off the light, the original resistance is almost instantly reached if a very low intensity has been used. If a very sensitive galvanometer is at hand, a lower applied voltage is more satisfactory. Fig. 3 shows a characteristic curve of one of these cells on a potential of 10 volts when exposed to various light intensities. These curves vary with the individual cell used, the light intensity and the applied voltage. Each cell should be studied under the conditions for which it is to be used.

For measuring much more intense radiation than that of stellar magnitude, the author suggests the reduction of the exposure to a fraction of a second in order to do away with any time change factor. A camera shutter operated at 0.01 or 0.02 of a second will give a good reading on a ballistic galvanometer and by comparing the throws of the source to be measured with the throws of a known calibrated source, very accurate results may be obtained. It is suggested that this method be tried for very high temperature measurements.

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