# THE RESPONSE OF THE WESTON PHOTRONIC CELL TO X-RAYS

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It has been found independently by us, Paul R. Gleason[1], of Colgate University, and others[2] that photovoltaic cells respond to x-rays in much the same way as they do to light.

A thorough study of the properties of the Weston Photronic cell was therefore undertaken with the idea of determining its advantages and limitations for routine intensity measurements such as occur in an x-ray laboratory. To prepare these cells for use with x-rays, several layers of thick black paper were substituted for the glass front of the cells. Tubes with tungsten and molybdenum targets were used as the sources of x-rays, and the current output of the cells was measured with a galvanometer of 505 ohms resistance and a sensitivity of $10^{-10}$ amperes per millimeter. The cell's response at different wave lengths was compared with a standard ionization chamber operated with a potential of 1450 volts.

In accordance with Gleason's results, the cell's response was not found to be proportional to that of the ionization chamber, the cells being relatively more sensitive at shorter wave lengths. The current per "e" unit was determined as 1.7 microamperes as compared with Gleason's value of 1.2. Cells giving the same response to light do not necessarily respond the same to x-rays. Variations of as much as 50 per cent were found among the cells used. However, individual cells give constant results over a period of weeks. Special shielding of cells and connections against electrostatic surges, which was done by Gleason to prevent breakdown of contacts at the thin metallic electrodes, proved unnecessary if the x-ray tube was not operated above 120 kv. and the cells were kept at a distance of more than 18 inches from the tube.

A certain time lag in the response of the cell to incident x-rays exists. The time of this lag is of the order of 20 seconds. The final output, however, remains constant for an indefinite time. This may be compared to a very much shorter time lag which is observed in the response of the cell to visible light.

There was also a decided dark current evidenced by the slow return of the galvanometer to zero. The maximum magnitude of this dark current is roughly independent of the intensity, but the total duration of the current increases with intensity. After an intensity of 0.03 "e" units has been falling on the cell, the dark current falls to about 10 per cent of its original value in 10 minutes. Under these same conditions the magnitude of the dark current is roughly 10 per cent of the current given by the cell when activated by x-rays. The final reading of the galvanometer, however, is not affected by the dark current. This means that, once the zero position of the galvanometer has been determined when there is no dark current, the final reading of the galvanometer is a true measure of the x-ray intensity.

Upon subjecting the cells to different temperatures, their reaction

[1]Gleason, 1933. Phys. Rev. 43:775A. Gleason, 1933. Phys. Rev. 44:330A.
[2]Zeits. f. Physik 80:465. 1933.

was found to depend on the temperature. An increase in temperature produces a decrease in response. The rate of decrease in response is less at higher temperatures than at low. This characteristic was investigated over a range of 50°C. around room temperature. For an increase of 20°C. above room temperature the decrease in response was about 15 per cent, while for a decrease of 10°C. below room temperature the increase in response was about 50 per cent.

The current output of these cells is much smaller for x-rays than for light. This is due to the fact that a large proportion of the x-rays pass through the blocking layer without being absorbed. For usual x-ray intensities a galvanometer of $10^{-9}$ amperes per millimeter deflection is required as compared to a microammeter for light.

The cell's response is almost linear to x-rays of moderate intensity provided the cell works into an external resistance of about 500 ohms or less. When larger external resistances are used the response becomes proportionately less with increasing intensity. This is strikingly similar to the linearity of the cell to light intensities when different external resistances are used. As in the case of light, the linearity is increased by decreasing the external resistance. Good results have been obtained with large intensities which permitted the use of a galvanometer of low resistance. With low intensities, however, it is necessary to use a galvanometer of high resistance, which causes the response to be non-linear.

The advantages of the cell in measuring x-ray intensities are its large current output as compared to the ionization chamber and the fact that no external potential is required. The disadvantages of the cell are its slow response, dark current, and temperature effect. The latter is the only one of importance, and that is practically eliminated if the cell is used in a laboratory where the temperature is fairly constant. These results indicate that if the temperature is kept fairly constant the Weston Photronic Cell is well adapted for the measuring of relative x-ray intensities when absolute intensity is not important.