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PHOTOELECTRICAL EMISSION FROM CADMIUM FILMS

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When an alkali-metal film of atomic dimensions is deposited slowly in high vacuum, the photoelectric threshold wave-length moves from the blue end of the spectrum toward the red, reaches an extreme value which for the majority of the alkali metals is in the infrared, and then recedes again to the final value characteristic of the metal in bulk. In the case of mercury*, on the other hand, films deposited slowly in a high vacuum on an oxidized iron plate maintained at liquid air temperature (Figure 1) show no indication of a large shift in threshold wave-length.

*Roller, Jordan and Woodward, Phys. Rev. 38; 396 (1931); Woodward and Roller, Okla. Acad. Sci. Proc. 11: (1931).

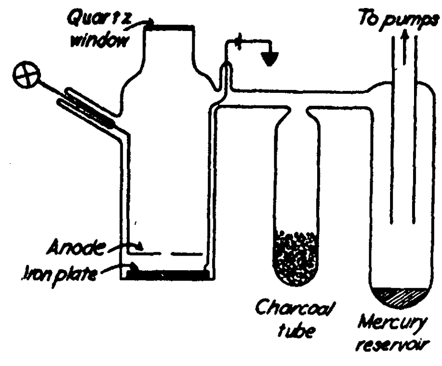

Fig. 1. Diagram of the photoelectric cell used for the study of mercury films. A similar type of cell was used in the investigation of cadmium films.

In the present work the object has been to observe the behavior of the photoelectric threshold wave-length for films of cadmium deposited on iron in a high vacuum. Since the threshold wave-length of cadmium in bulk has been fairly well established at 3040 A**, preliminary experiments were made with a photoelectric cell having a cathode made of bulk cadmium; the results obtained with this cell were similar to those obtained by other workers. No study other than the present one has been made of thin films of cadmium.

In order to be able to design a satisfactory cadmium-film cell, it was first necessary to study and to improve the known techniques for producing, by evaporation in high vacuum, films of a metal like cadmium, which has a high boiling point. In this preliminary work four different cells were constructed and discarded.

The design of cell finally adopted was similar to that shown in Fig. 1. It consisted of a Pyrex glass tube 4 cm in diameter, to the upper end of which was sealed a graded quartz-Pyrex seal containing a quartz window and to the lower end a plane Pyrex plate which formed the bottom of the cell. In contact with the latter was a 3.3 cm disk of oxidized Swedish wrought iron upon which the film of cadmium was made to deposit. This plate was maintained at 120 volts negative to ground. The anode was fashioned from tungsten wire in such a manner as to present a large receiving surface to the cadmium film. Two small bulbs, connected in series, were sealed to the cell and in the outer one of these was contained the spectroscopically pure cadmium. The cell and bulbs were evacuated and thoroughly baked, then the cadmium was distilled from the first bulb into the second, and finally the cadmium film was formed on the iron plate in the bottom of the cell by heating the second bulb in an oven. Films were formed both when the iron plate was at room temperature and at the temperature of liquid air. The source of radiation, electrometer system and evacuation apparatus were the same as those used in the previous work with mercury.*

The results obtained so far with cadmium films are very similar to those previously obtained with mercury.* As each film increased in thickness, the photoelectric current increased from zero to a maximum value but there was no indication of a large shift in threshold wave-lengths at any time during the formation of the film.

We wish to acknowledge our indebtedness to the New Jersey Zinc Company for the donation of spectroscopically pure cadmium used in this work.

**Bomke, Ann. d. Physik. 10: 5, 579 (1931).