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LIGHT-SENSITIVE CELL MANUFACTURE

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1 Claim. (Cl. 291—63)

The invention relates to the manufacture of selenium cells of the type shown in the patent to Carpenter, No. 1,942,598, wherein use is made of a glass support which carries a layer of platinum separated into two electrodes by a sinusoidal trace. Selenium, or similar light-sensitive material, is sublimed onto and bridges the gap between the adjacent electrode portions.

Selenium occurs in several allotropic forms, only some of which are light-sensitive. It has heretofore been proposed to sublime some selenium or the like onto a grid without controlling the growth of the crystals on the grid, whereby the grid is coated with a mixture of two or more allotropic forms. This defect has been overcome heretofore by annealing the coated grids in order to convert the lower photo-sensitive crystals into the desired photo-sensitive crystals.

According to the present invention, I control the crystal growth at the time that the vapor is originally sublimed on the grid, thereby insuring that the proper crystals are originally formed on the grids and making it unnecessary to later anneal the grids.

It has heretofore been determined that the photo-sensitive form of selenium is crystallized from its vapor at a temperature from 140° to 145° C. For other light-sensitive materials which can be deposited by sublimation, this temperature would have other known values for proper crystal growth.

According to the present invention, in the case of selenium, the electrode surfaces are, during sublimation, maintained at an elevated temperature, such as 140° to 145° C, whereby the electrodes receive the vapor of the light-sensitive material at the correct temperature for the growth of photo-sensitive selenium crystals. As disclosed and claimed in my co-pending application, Serial No. 9,584, filed March 6, 1935, for Light sensitive cell manufacture, the fineness of grain is improved by scraping off the first sublimed coating, and subliming another coat on the electrodes, the steps of coating and scraping being repeated a number of times, as the formation of subsequent layers is hastened by former crystallizations. A final coat is sublimed on the electrodes for a short time, such as a few minutes, which time is insufficient for large crystals to form.

For further details, reference may be made to the drawings wherein:

Fig. 1 is a plan view of an oven which may be employed for performing the method of the present invention, the oven being shown in closed position.

Fig. 2 is a front elevation of the oven of Fig. 1.

Fig. 3 is a side elevation, partly in section, of the oven of Fig. 1.

Fig. 4 is a perspective view of the oven of Fig. 1 in open position.

Fig. 5 is a plan view of a cell element to be coated according to the present invention.

Fig. 6 is a schematic diagram of a thermostat arrangement for independently regulating the temperature of the upper and lower heater plates of the oven of Figs. 1 to 4.

Referring in detail to the drawings, the oven comprises a lower heater plate 1, which supports the cell elements 2 of Fig. 5. These cell elements comprise interdigitated electrodes 3 and 4, separated by a sinusoidal trace 5, which may be from 1 to 5 mils wide. These cell elements comprise a glass support 6, to which the electrodes 3 and 4, which may be platinum, are fused (by a muffle furnace not shown), as disclosed in the patent to Lyon No. 1,948,706. The lower plate 1 is heated to a desired temperature by means of an electric heater 7, supported by the stud 8 and wing nut 9 below the plate 1. The furnace is supported by legs 10. The temperature of the lower plate may be observed by a thermometer 11, which extends across the front of the lower plate 1, as shown in Fig. 4, and which also extends in an aperture 12, in the lower plate 1, as shown in Figs. 1 and 3.

Hinged to the lower plate 1, at 13, is an upper heater plate 14, which is separated from the lower plate 1 by a rectangular insulating frame 15. The height of the frame 15 determines the separation of the two heater plates, and this distance should be about % inch to % inch. The upper plate 14 comprises the subliming surface, and it is heated by an electric heater 16, which is suitably fastened to plate 14 by the stud 17 and wing nut 18. The temperature of the upper plate 14 may be observed by thermometer 19, which extends in an aperture 20 in the plate 14, as well as under a hood 21, which supports thermometer 19 at 22 and 23.

As later described, the upper plate 14 is heated to a temperature considerably higher than the temperature of plate 1. To prevent plate 1 from acquiring, by radiation from plate 14, a temperature higher than that desired, I provide a plurality of apertures 24 in the lower plate 1, in order to increase the radiation of heat from the lower plate 1. The upper plate 14 is provided with a handle 25 by means of which the furnace may...
be opened, and in fact when in full open position the plate 14 is substantially horizontal for a purpose described later.

In order to independently regulate the temperature of the lower plate 1 and the upper plate 14, I provide the thermostats shown in Fig. 6, although any other temperature regulator may be used instead. As shown in Fig. 6, electric current is supplied by the power line 26 in circuit with which are the switches 27 and 28. A temperature regulator which expands and contracts within the desired range of temperatures, and which is illustrated at 29 in Fig. 1, is mounted in an aperture 30 in the lower plate 1. The regulator 29 controls the contacts 31 in series with the heating coil 32 for the lower plate. A condenser 33 is connected in shunt to the contacts 31. The circuit for the heating coil 32 is connected in series with the contact 34 of a series relay 35, the coil 36 of which is connected to the line 26 through the left hand portion of switch 27, and the lower terminal of which is connected in series with contact 31. When the temperature of plate 1 drops below the desired temperature, the contact 31 is closed, the relay 35 is energized, and the coil 32 is connected to the line 26. When the temperature of plate 1 rises above the desired temperature, the contacts 31 open, the coil 36 is de-energized, and the heater 32 disconnected from the line 26.

The temperature regulator for the upper plate 14 of Fig. 6 comprises a known arrangement according to which vapor pressure in a conduit 37 actuates the needle 38 of a regulator 39. The conduit 37 connects with aperture 40 in the plate 14, to actuate the needle 38 in accordance with the temperature of plate 14 in a known manner. When the temperature of plate 14 is too low, the needle 38 moves to the left, whereby line current is supplied from terminal 41 through resistance 42, the coil of relay 43, left contact closed by needle 38, to the other side of the line 44, to thereby energize relay 43. When relay 43 actuates, it connects the coil 46 of heater 16 to the line to contact 45, and it also provides a holding circuit for relay 43 through contact 46. When the temperature of plate 14 is too high, the needle 38 moves to the right to short-circuit the relay 43 which releases, thereby disconnecting the heater 16 from the line.

When the furnace in Figs. 1, 2, 3, and 4 is fully opened, the upper heater or sublimging surface 14 is horizontal, and in this position it is sprinkled while hot with a thin coating of the subliming mixture which may, for example, comprise 19 parts of powdered selenium intimately ground with 1 part of powdered tellurium. The subliming surface 14 at this time should have a temperature of about 245° C. or higher, preferably 295° C., whereby the subliming mixture melts to form a pasty coating on surface 14, as indicated at 41. The furnace is now closed as shown in Fig. 3, with a cell element 2 supported on the lower plate. The lower plate is maintained by the thermostat described in Fig. 6, at a temperature such that the elements 2 are kept below the melting point of the subliming mixture 41, and in the case of selenium, at a temperature of 140° to 145° C., whereby the elements 2 receive the vapor at the correct temperature for the growth of the particular allotropic form of selenium which is photo-sensitive. At this time, the upper plate 14 is regulated by the regulator of Fig. 6, to a temperature of 240° C. or higher, preferably 290° C., depending on the desired rate of evaporation of vapor.

As described in my co-pending application, Serial No. 9,584, filed March 6, 1935, for Light sensitive cell manufacture, the sublimation may proceed for from one to one and one-half hours, resulting in a soft coating which is scraped off the electrodes 3 and 4, the sublimation and the removal thereof being repeated five or six times, the time of such sublimations being successively reduced until the final coating, which is accomplished with a fresh charge of the subliming mixture, is effected in a short time, such as four and one-half minutes. During the final coating, the upper plate 14 may be heated to an elevated temperature such as 325° C. After removing the coated grids 2 from the furnace, the deposit of sublimed material on the surface of the electrodes 3 and 4 outside of the interdigitated portion, is scraped away and two drops of a dilute solution of iodine in carbon disulphide is used to wet the deposit. Iodine possibly reacts with traces of oxide present to reduce it to selenium and tellurium. Excess iodine forms selenium and tellurium iodide. The coated trace 5 may be protected with a cap not shown, and the cell element mounted for use as shown in the Patent to Lyon, No. 1,948,768.

I claim:

The method of simultaneously and similarly depositing selenium on a plurality of individual cells each having a pair of electrodes thereon which comprises heating all of said plurality of cells uniformly to substantially the same temperature, regulating said temperature to maintain said cells within a range of temperature between 140° C. and 145° C., and separately regulating the temperature of said selenium paste to maintain said temperature within a range of between 245° C. and 295° C.

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