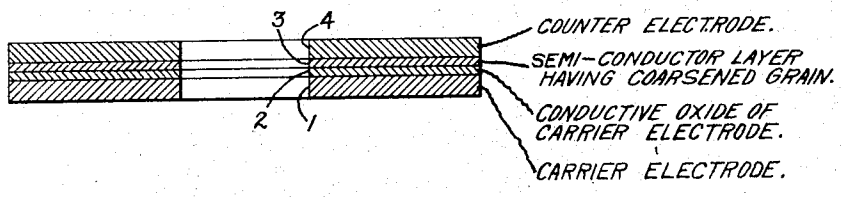
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DRY PLATE ELEMENT AND METHOD OF PRODUCING THE SAME

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DRY PLATE ELEMENT AND METHOD OF PRODUCING THE SAME

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Our invention relates to dry plate rectifiers or like devices, having a semi-conductor layer, particularly a semi-conductor layer consisting of or comprising selenium. It is the general object of the invention to impart to the semi-conductor layer, which is produced by the method including applying a vapor of the semi-conductor material in a vacuum or in a neutral atmosphere to form a crystalline layer on the carrier electrode, such a surface texture as will provide, by means of a simple method, especially favorable conditions for the formation of a natural blocking layer.

It is known that when the semi-conductor layer of a dry plate element, of the selenium type is produced by applying the semi-conductor material in the melted condition to the carrier electrodes, the disadvantage is encountered that a selenide is formed. This known method has other disadvantages. For example, the internal resistance of the resulting semi-conductor layer is relatively high, since, in spite of subsequent pressure treatment, the texture of the layer thus produced is not sufficiently homogeneous or close, and no reduction in the thickness of the layer is possible beyond a certain point, as 0.1 millimeter, without risk of producing non-uniform layers. Further, by the pressure treatment too smooth a surface of the semi-conductor surface is obtained, which renders the forming of a dependable blocking layer very difficult. Further, in general, the processes heretofore known for additional treatment which are intended to improve the surface of the semi-conductor layer formed by the above-mentioned melting process have not led to uniformly satisfactory results.

To obviate the disadvantages encountered in applying the semi-conductor material in the melted condition, a method is known in accordance with which the semi-conductor layer is formed on the carrier electrode by applying, to this electrode, vapor of the semi-conductor material in a vacuum, or in the presence of a neutral vapor or gas at a suitable regulated pressure. The present invention relates particularly to this latter method and to dry plate elements produced in accordance therewith. In the use of this latter method, especially if the carrier electrode is heated simultaneously with the subjecting of the electrode to the vapor, a semi-conductor layer of crystalline structure is directly obtained, and therefore no special operations for converting amorphous selenium into crystalline selenium are required.

It has been found, however, that in the use of the latter method the surface texture even of such a semi-conductor layer, directly produced in a crystalline modification of the material, does not provide, with a uniformity adequate to the demands of mass production, favorable preliminary conditions for the production of a sufficiently nearly perfect blocking layer.

The above-noted disadvantage characterizing the latter method is obviated, in accordance with the present invention, in that the semi-conductor layer which is produced by one of the described or other suitable vaporization methods and which constitutes a crystalline film on the carrier electrode, is subjected to an additional heat treatment which has the effect of coarsening the grain or texture of the crystalline film. By the use of this heat treatment in accordance with the invention, less difficulty is experienced from effects which may influence adversely the crystalline texture, and a greater degree of independence is had in the choice of conditions for the applying of the vapor of semi-conductor material.

Our invention will be better understood from the following description when considered in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

Referring to the drawing, the single figure thereof illustrates a dry plate rectifier element or like device, such as a light sensitive cell, in which a semi-conductor layer in accordance with our present invention has been incorporated.

In the figure of the drawing, the dry plate cell or element illustrated therein may be of the selenium type. The element comprises a carrier electrode 1 which may be of aluminum having its natural oxide layer 2 thereon. The layer 2 is made conductive by a known process including, for example, exposing the oxide coated plate to the vapor of suitable metals, or by bombardment with ions of a reducing gas or vapor. The oxide coated carrier electrode 1 thus treated is then provided with a semi-conductor layer 3, in accordance with the known vaporization process hereinabove mentioned. The carrier electrode is heated to a temperature of approximately 140 degrees C. in a high vacuum, and on its surface is deposited, by the vaporization process, a selenium layer, or suitable layer comprising selenium, approximately 10^{-2} millimeter in thickness. The selenium layer or film rapidly adheres to or grows upon the aluminum plate as a conductive and crystalline modification of the semi-conductor material.

The oxide coated carrier electrode 1, supporting thereon the semi-conductor layer 3, is next subjected to the heat treatment in accordance with the present invention. This heat treatment is preferably performed at a higher temperature than is employed in the above-mentioned vaporization process for applying the semi-conductor to the carrier electrode, since the higher temperature promotes the coarsening of the grain or texture favorable to the formation of the block-

ing layer. To carry out most simply the method in accordance with the present invention the heat treatment may be performed in air, preferably at a pressure above atmosphere, since the increase in pressure of the air tends to assist in coarsening the surface structure of the semi-conductor layer. For this purpose the carrier electrodes or plates 1 having thereon the semi-conductor layers 3, are placed in an oven of suitably large heat capacity, the temperature of which is maintained at approximately 215 degrees C. The plates remain in the oven for a period of approximately 30 minutes. The heat treatment may be performed at a lower temperature, but in this case the period of treatment must be extended materially. In arranging the plates in the oven care must be taken that the selenium surfaces of the plates are exposed. It is possible to shorten the time required in the above-described heat treating of the selenium coated plates by increasing the pressure in the oven to approximately three atmospheres. Also, to accelerate the heat treatment of the selenium coated plates, it is possible by introducing selenium into the oven in which the selenium coated plates are placed, to produce a selenium vapor pressure which corresponds to a temperature range of 230 to 250 degrees C.

The plates 1, supporting thereon the semi-conductor layer 3 having been heat treated as above described to provide in the semi-conductor layer a coarsened texture facilitating the formation of the blocking layer, are next subjected to a rapid cooling process in order that the texture may be maintained. For this latter purpose, the plates after being taken from the oven, are quickly cooled in an air current supplied by a fan, for example. Finally, the counter-electrode 4 may be applied to the selenium coated copper electrode or plate in any known suitable manner.

The method of heat treating in accordance with our invention, to coarsen the texture of the semi-conductor layer and thereby to facilitate the formation of the blocking layer is of particular advantage in connection with dry plate cells of the selenium type, as described herein. The method is not, however, limited to such type but may be applied with advantage to other dry plate cells having similarly operating semi-conductor layers. For example, the method may be applied to dry plate cells having semi-conductor layers consisting of or comprising tellurium.

Our invention has been described herein in particular embodiments for purposes of illustration. It is to be understood, however, that the invention is susceptible of various changes and modifications and that by the appended claims we intend to cover any such modifications as fall within the true spirit and scope of our invention.

What we claim as new and desire to secure by Letters Patent of the United States, is:

1. The method of producing a dry plate element having a carrier electrode coated with semi-conductor material comprising selenium applied as a vapor to said electrode heated simultaneously with the application of said vapor thereto to form thereon a crystalline layer, which includes heating in air said coated electrode subsequently to a still higher temperature to coarsen the texture of said layer, said layer being exposed to said air during said subsequent heating, and subjecting said coated electrode to a rapid cooling to maintain said coarsened texture.

2. The method of producing a dry plate element having a carrier electrode coated with semi-conductor material comprising selenium applied as a vapor to said electrode to form thereon a crystalline layer, which includes heating said coated electrode at a temperature of approximately 215 degrees centigrade for approximately 30 minutes to coarsen the texture of said layer, and subjecting said coated electrode to a rapid cooling to maintain said coarsened texture.

3. The method of producing a dry plate element having a carrier electrode coated with a semi-conductor material comprising selenium applied as a vapor to said electrode to form thereon a crystalline layer, which includes heating said coated electrode to a higher temperature than employed in applying said material to said electrode in a medium at a pressure of substantially three atmospheres, thereby to coarsen the texture of said layer, and subjecting said coated electrode to a rapid cooling to maintain said coarsened texture.

4. The method of producing a dry plate element having a carrier electrode coated with a semi-conductor material comprising selenium applied as a vapor to said electrode to form thereon a crystalline layer, which includes heating said coated electrode to a higher temperature than employed in applying said material to said electrode in a medium at a pressure substantially above atmosphere to coarsen the texture of said layer, and subjecting said coated electrode to a rapid cooling to maintain said coarsened texture.

5. The method of producing a dry plate element having a carrier electrode coated with a semi-conductor material comprising selenium applied as a vapor to said electrode to a higher temperature than employed in applying said material to said electrode to form thereon a crystalline layer, which includes heating said coated electrode in a medium comprising selenium vapor at a pressure corresponding to 230 to 250 degrees centigrade, thereby to coarsen the texture of said layer, and subjecting said coated electrode to a rapid cooling to maintain said coarsened texture.

6. The method of producing a dry plate element having a carrier electrode coated with a semi-conductor material comprising one of the group including selenium and tellurium applied as a vapor to said electrode heated simultaneously with the application of said vapor thereto to form thereon a crystalline layer, which includes heating in air said coated electrode subsequently to a still higher temperature to coarsen the texture of said layer, said layer being exposed to said air during said subsequent heating, and subjecting said coated electrode to a rapid cooling to maintain said texture.

7. A dry plate element including a carrier electrode, a crystalline selenium semi-conductor layer applied to said electrode in the vapor state and having a permanently maintained coarsened texture, and a counter electrode in contact with said layer.

8. A dry plate element including a carrier electrode, a crystalline semi-conductor layer applied to said electrode from a vapor of material of the group comprising selenium and tellurium and having a permanently maintained coarsened texture, and a counter electrode in contact with said layer.

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