

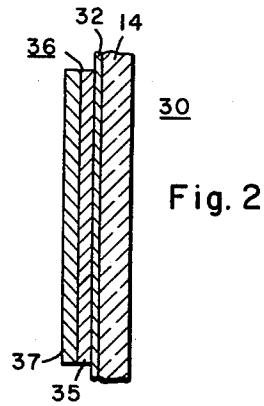
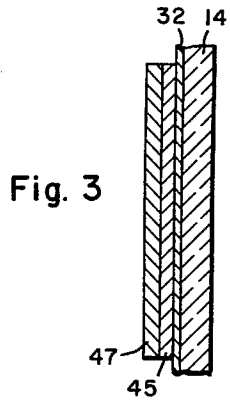
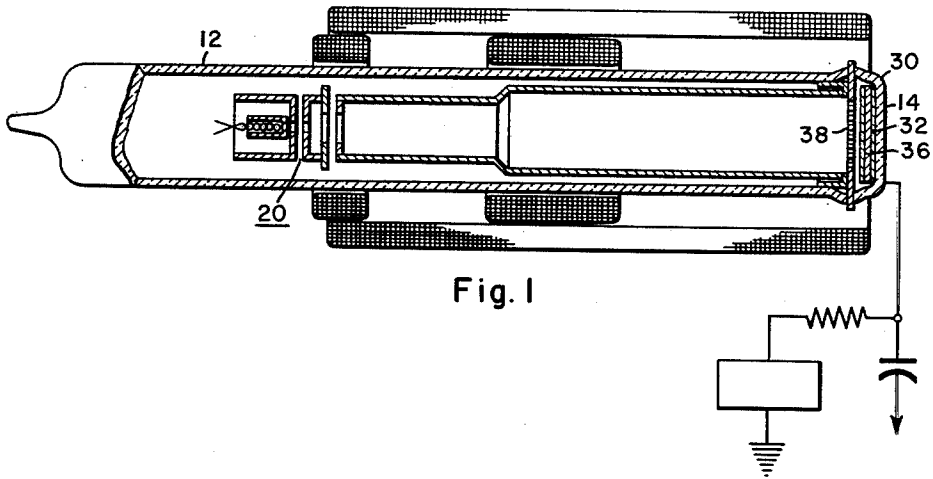
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METHOD OF MAKING A PHOTOCONDUCTIVE TARGET

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WITNESSES

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METHOD OF MAKING A PHOTOCONDUCTIVE TARGET

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8 Claims. (Cl. 117-211)

This invention relates to photoconductive targets and more particularly to a photoconductive target for a pickup tube.

One particular application of this photoconductive target is in a pickup tube known as a vidicon. The vidicon comprises an evacuated envelope having a glass face plate transmissive to light with a light transmissive electrically conductive film coated on the inner surface of the face plate. The conductive coating is the signal plate for the target. A layer of a photoconductive material is deposited on the conductive film. An electron gun is provided for scanning the target member. The cathode of the electron gun is at a negative potential with respect to the signal plate. The electrons within the beam may be of high energy, that is, above the first crossover potential and below the second crossover potential of the target, or they may be of a low energy below the first crossover potential of the target. The most common type of operation is utilizing the low energy electron beam. As the electron beam is scanned across the target, electrons are deposited on the surface of the target and the surface is charged to substantially the potential of the cathode of the electron gun. When light is focused upon an area of the target, it renders the photoconductive material conductive in that particular area and causes a corresponding portion of the scanned surface of the photoconductive layer to charge in a direction toward the potential of the signal plate. The next time the electron beam scans this area it again restores the surface to cathode potential. This return to cathode potential restores the original voltage difference across the photoconductive layer and causes an electron current to flow in the signal plate. This electron current which flows in the signal plate is coupled to an output circuit to derive an electrical signal representative of the light directed on the area of the photoconductive layer.

The photoconductive material utilized in the target of the vidicon type pickup tube should be an insulator in the dark. In practice, materials with a resistivity of at least 10^{12} ohm centimeters have been found suitable. Another important property of the photoconductive material is its sensitivity which is the ability of the material to become conductive under the influence of light. This is measured usually in microamperes of video current output for a lumen of light on the target. It is also desirable to provide a uniform layer of photoconductive material. By this, it is meant that the target is substantially uniform in response to light across its entire surface. It is also found that if the layer is not uniform that the target when scanned with no illumination may provide a mosaic type output which is undesirable.

It is accordingly an object of this invention to provide an improved photoconductive material.

It is another object to provide an improved photoconductive target of high sensitivity for a pickup tube.

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It is another object of this invention to provide an improved photoconductive target of uniform sensitivity.

These and other objects are effected by my invention as will be apparent from the following description, taken in accordance with the accompanying drawing, throughout which like reference characters indicate like parts, and in which:

FIGURE 1 is a view in section of a pickup tube embodying the invention;

FIG. 2 is an enlarged sectional view of the target shown in FIG. 1; and

FIG. 3 is a sectional view of a modified target for use in the tube shown in FIG. 1.

Referring in detail to FIG. 1, there is illustrated a pickup tube. The tube comprises an evacuated glass envelope 12 containing an electron gun assembly 20 and a target 30. The envelope 12 includes a face plate 14 coated on its inner surface with a light transmissive electrically conductive film 32. The film 32 may be of a material such as tin oxide. The film or coating 32 is the signal electrode of the target 30, and an electrical connector extends through the wall of the envelope 12. The photoconductive material is deposited as a layer 36 upon the electrically conductive film 32. Immediately in front of the photoconductive layer 36 and between the target 30 and the electron gun 20 is a conductive mesh 33 which provides a uniform decelerating field for electrons. The general operation of the tube has previously been discussed and is well known in the art.

In the specific embodiment shown in FIG. 2, the photoconductive member 36 consists of two layers 35 and 37. The layer 35 is deposited on the conductive layer 32 to provide a porous layer of a mixture of cadmium sulfide and antimony trisulfide. The layer 35 is a smoke-like layer formed by an evaporating a mixture of cadmium sulfide and antimony trisulfide from a boat in an inert gas such as argon onto the support. The layer 37 which is deposited on the porous layer 35 has a greater bulk density than the porous layer and is formed by evaporating a mixture of cadmium sulfide and antimony trisulfide within a vacuum. The target may also be fabricated by placing the vacuum deposit layer 37 on the conductive layer 32 and then the smoke-like layer 35 on the vacuum layer. However, this latter structure is found to be difficult to control because of the critical smoke-type layer.

In preparing targets in accordance with this invention, the antimony trisulfide and the cadmium sulfide are mixed together in their metal form in air or vacuum. The mixture is then heated to a temperature of about 500° C. for a period of about 25 minutes or until the combination of material takes place. After this combination has taken place, the mixture is allowed to cool to room temperature. It was found that mixtures which had 20% to 40% of cadmium sulfide by weight gave excellent results. The glass support member 14 having a conductive coating 32 thereon is then placed in a closed container capable of being evaporated. A small quantity of the mixture, say about 60 milligrams, is suitable for depositing the layer 35 on a one inch diameter target. The mixture is placed in a suitable boat, such as Nichrome, and inserted into the container and positioned at a distance approximately one inch from the target. The system is then exhausted and then argon gas is introduced into the container to a pressure of about 150 microns. It has also been found

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desirable to provide two fine mesh screens about 400 mesh between the target support and the boat holding the mixture. The utilization of the mesh screens improves the quality of the surface and the yields of high sensitive tubes. The mesh also improved uniformity of the layer by breaking up gas convection flow within the system. The boat is then heated to approximately 400° C. to 500° C. which evaporates the material from the boat. The heating is continued for approximately 3 to 4 minutes until a layer of a thickness of about 3 microns is obtained. The evaporator utilized consists of a circular disc which reflects light from a tungsten source of 11.3 watts and 2.7 amperes positioned at a distance of 10 inches from the target. The color of the light reflected from the evaporator after transmission through the target is observed during the target evaporation process. When a yellow-brown color is observed, the heat is turned off and the first layer 35 of the target has been completed. The layer 35 is a porous smoke-like layer having less density than the bulk density of the material.

The system is now exhausted again to remove the inert gas and is exhausted to a vacuum of about 10^{-6} microns or less. Again, a boat containing about 60 milligrams of the mixture of antimony trisulfide and cadmium sulfide is positioned within the container about 2 inches from the target and heated to a temperature of 400° C. to 500° C. to deposit the second layer 37 on the target member and provide a vacuum-type layer. The evaporation process continues until a thickness of about 2 microns is obtained such that the boat does not disappear from view to the observer. The layer 37 is the material at normal bulk density. The target member is then baked at a temperature of about 150° C. for a period of about 15 minutes. This baking operation may be performed in air or in a vacuum. The resulting target was found to have an extremely high sensitivity. The bake temperature may vary from 100° C. to 250° C. and the time period may be modified in accordance with temperature.

In FIG. 3, there is illustrated another embodiment of the invention in which the first layer deposited on the conductive layer 32 of the target is a layer 45 of cadmium sulfide. The cadmium sulfide layer is evaporated in a vacuum system such as described previously with regard to the mixture and again the boat positioned at a distance of about 5 inches from support and is heated to a temperature of about 400° C. to 500° C. The evaporation is stopped when a light yellow color is observed. The thickness of this layer is about 2 microns. After the completion of the vacuum deposited layer 45 of cadmium sulfide, a second layer 47 of a smoke-like or porous film of antimony trisulfide is evaporated onto the cadmium sulfide layer 45. The layer 47 is obtained by evaporating the antimony trisulfide in a similar manner as that described with respect to the layer 35 in the embodiment shown in FIG. 2. The layer is evaporated at a temperature of about 400° C. to 500° C. and to a thickness of 2 microns such that the observer will see that the boat is not obscured from view. Again, it is necessary to bake the resulting target at about 150° C. for a period of 15 minutes in a vacuum or air in order to obtain a highly sensitive target.

While I have shown my invention in only two forms, it will be obvious to those skilled in the art that it is not so limited but is susceptible of various changes and modifications without departing from the spirit and scope thereof.

I claim as my invention:

1. The method of making a light sensitive target for an electron discharge device which comprises, coating a light transparent support member with a transparent electrically conductive film, heating a quantity of a mixture of antimony trisulfide and cadmium sulfide in an inert atmosphere to evaporate a porous light sensitive layer on said electrically conductive film, and then heating a quantity of a mixture of antimony trisulfide and cadmium sul-

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fide in a high vacuum to evaporate a light sensitive layer having a greater bulk density than said porous layer onto said porous layer.

2. The method of making a light sensitive target for an electron discharge device which comprises, coating a light transparent support member with a transparent electrical conductive coating, evaporating a quantity of cadmium sulfide material onto said electrically conductive coating in a high vacuum and evaporating a quantity of antimony trisulfide material in an inert atmosphere onto said cadmium sulfide layer to form a porous layer thereon.

3. The method of making a light sensitive target for an electron discharge device which comprises, coating a light transparent support member with a transparent electrical conductive coating, evaporating a quantity of cadmium sulfide material onto said electrically conductive coating in a high vacuum, evaporating a quantity of antimony trisulfide material in an inert atmosphere onto said cadmium sulfide layer to form a porous layer thereon, and subjecting said light sensitive target to a heat treatment.

4. The method of making a light sensitive target for an electron discharge device which comprises, coating a light transparent support member with a transparent electrically conductive film, heating a quantity of a mixture of antimony trisulfide and cadmium sulfide containing between 20% to 40% cadmium sulfide by weight in an inert atmosphere to evaporate a porous light sensitive layer onto said electrically conductive film, and then evaporating a photoconductive material onto said porous light sensitive layer in a high vacuum to form a light sensitive layer having a greater bulk density than said porous layer.

5. The method of making a light sensitive target for an electron discharge device which comprises, coating a light transmissive support member with a light transmissive electrically conductive film, heating a quantity of a mixture of antimony trisulfide and cadmium sulfide in an inert atmosphere to evaporate a porous light sensitive layer onto said electrically conductive film, and then heating a quantity of photoconductive material in a high vacuum to evaporate a light sensitive layer having a greater bulk density than said porous layer onto said porous layer.

6. The method of making a light sensitive target for an electron discharge device which comprises, coating a light transparent support member with a transparent electrically conductive film, heating a quantity of a mixture of antimony trisulfide and cadmium sulfide containing between 20% to 40% cadmium sulfide by weight in an inert atmosphere to evaporate a porous light sensitive layer onto said electrically conductive film, and then heating a quantity of a photoconductive material in a high vacuum to evaporate a light sensitive layer having a greater bulk density than said porous layer onto said porous layer, and then heating said light sensitive target to a temperature of 100° to 250° C. for a period of 15 minutes.

7. The method of making a light sensitive target for an electron discharge device which comprises, coating a light transmissive support member with a light transmissive electrically conductive film, heating a quantity of a mixture of antimony trisulfide and cadmium sulfide containing between 20% to 40% cadmium sulfide by weight in an inert atmosphere to evaporate a porous light sensitive layer onto said electrically conductive film, heating a quantity of a mixture of antimony trisulfide and cadmium sulfide containing between 20% to 40% cadmium sulfide by weight in a vacuum to evaporate a light sensitive layer onto said porous layer, said vacuum deposited layer having a greater bulk density than said porous layer and then subjecting said porous light sensitive layer and vacuum deposited light sensitive layer to a heat treatment.

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8. The method of making a light sensitive target for an electron discharge device which comprises, coating a light transmissive support member with a light transmissive electrically conductive film, heating a quantity of a mixture of antimony trisulfide and cadmium sulfide containing between 20% to 40% cadmium sulfide by weight in an inert atmosphere to evaporate a porous light sensitive layer onto said electrically conductive film, and heating a quantity of a mixture of antimony trisulfide and cadmium sulfide in a high vacuum to evaporate a light sensitive layer onto said porous layer, said vacuum de-

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posited layer having a greater bulk density than said porous layer.

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