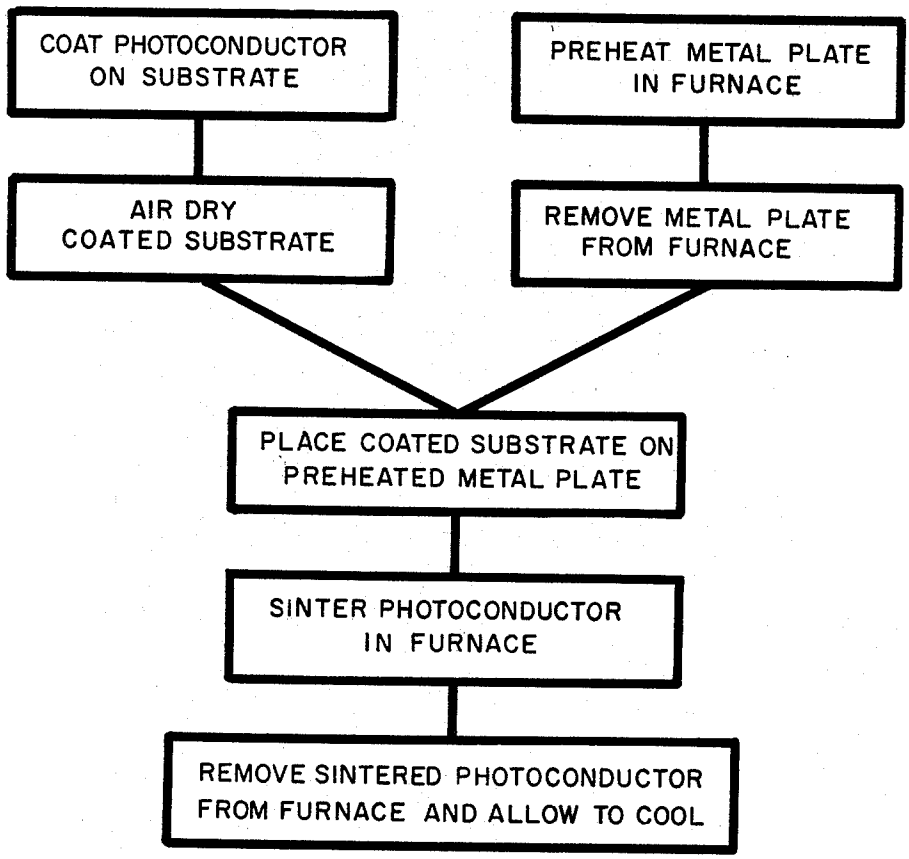
Nov. 5, 1963 D. L. COLE 3,109,753

PHOTOCONDUCTOR SINTERING PROCESS

Filed Nov. 8, 1961



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3,109,753

Patented Nov. 5, 1963

3,109,753

PHOTOCONDUCTOR SINTERING PROCESS

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Filed Nov. 8, 1961, Ser. No. 150,872
3 Claims. (Cl. 117—201)

This invention relates to photoconductors and more particularly to a method of uniformly sintering photoconductor material coated upon a substrate.

Photoconducting materials have found many applications in devices for light amplification in the television art or for data storage in the computer art. Almost all of the devices developed for these arts have utilized a layer of photoconductor material contigous or nearly contiguous with a layer of electroluminescent material. An exciting voltage is applied across the two layers in series and a voltage drop across each layer then exists. Light falling upon the layer of photoconductor material causes its resistance to be lowered and the voltage drop across the photoconductor layer drops while that across the electroluminescent layer increases, causing the latter to emit light of an intensity corresponding to the voltage change. To produce a uniform reduction in resistance throughout the entire device, the composition of other photoconductor material should not deviate from one location on the layer to another.

In the processing procedures previously utilized throughout the industry, such requirements of uniform composition were quite difficult to fulfill. Since the photoconductor is generally prepared of materials such as cadmium sulfide, cadmium selenide or cadmium selenium sulfide, activated with copper and a halide co-activator, for example chlorine or bromine, the sintering tends to drive off the volatile substances. If the entire coated substrate is not uniformly heated, more of the volatiles such as the halides will be driven off from the warmer areas than from the cooler areas, thus presenting different quantities of activation in one portion of the photoconductor surface than another. Because photoconductivity is related to the amount of chloride present, such uneven volatization of activator is undesirable.

A widely accepted method of sintering the photoconductor was to preheat a diatomaceous earth block such as Maranite in the furnace to near the sintering temperature of the photoconductor. The coated substrate was then placed upon this block and heated until equilibrium temperature was reached and the photoconductor was thus sintered. But with this method, the periphery of the substrate reached equilibrium temperature before the center. When finally the center reached equilibrium, the edges were overheated or at least were held at equilibrium temperatures for a longer period of time than the center. Thus excess volatiles were driven from the photoconductor and the edges were adversely affected. Furthermore because the heat transfer from the refractory was rather slow, the glass tended to build up inordinate strains and cracking often ensued.

Accordingly, the primary object of my invention is the realization of uniform sintering of a photoconductor layer.

Another object of my invention is the production of a sintered photoconductor having uniform emission over its entire surface.

Other objects, advantages, and features of the invention will be apparent from the following specification wherein a preferred embodiment of my invention is described by way of illustrative example.

The drawing is a flow sheet illustrating the procedural steps which may be used in fabricating a sintered photoconductor according to my invention.

The photoconductor material used in this invention is prepared according to conventional techniques. Phosphor quality cadmium sulfide is mixed together with cadmium chloride and copper carbonate and given a preliminary firing which produces a small amount of sintering and preliminary incorporation of the activator components into the cadmium sulfide matrix. The material is then milled in xylene or other suitable solvent, such as benzine or toluene, to insure a reasonably uniform particle size, generally of 1 to 5 microns, which will yield a smooth appearing sintered layer when coated upon the substrate. Afterwards the mixture is dried and suspended in a vehicle such as a lacquer, a mixture of benzine and nitrocellulose, or a mixture of ethylcellulose and xylol. In this manner a coherent layer generally about .001 to .010 inch thick may be formed when the mixture is coated upon the substrate. This substrate may be for example, a glass plate or the face of an electroluminescent lamp. Procedures used for coating the substrate are those known to the art such as painting, spraying, flow coating or doctor-blading.

After application of the photoconductor-vehicle layer, the coated substrate is allowed to air dry at room temperature to volatilize a considerable portion of the organic prior to firing.

The method of firing the coated plate is particularly important, as I have pointed out above, because of the desirability of attaining uniform volatilization of the chloride over the entire surface of the photoconductor and eliminating cracking of the glass. According to my invention, I preheat a metal plate, generally of stainless steel stock at least $\frac{3}{32}$ inch thick and preferably about $\frac{3}{16}$ inch thick in a furnace. For preheating, I place the plate on a bridge support of Maranite blocks and raise the plate to a predetermined sintering temperature within the range of 500 to 700° C. When heated, the plate is quickly removed from the oven and the coated substrate is placed thereon. Quickly, the preheated plate and coated substrate is replaced into the furnace upon the refractory blocks. I have found that the plate must be larger than the substrate, if uniform heating is to be attained. Preferably the plate is about two inches larger at every point around the periphery of the substrate. When the equilibrium temperature for sintering 500 to 700° C. is reached, the heating is continued for about 1½ to 5 minutes to complete the operation. By placing the substrate upon the preheated plate, uniform volatization of the chloride is always attained in all areas of the coated photoconductor.

The principle behind my method is that the furnace is at a temperature sufficient to sinter the photoconductor and the metal plate is also at that same high temperature. By placing the substrate directly upon this preheated plate, the heat is transmitted directly into the substrate uniformly over the entire area. The result is an almost instantaneous heating action. The heat within the furnace is radiated downwardly upon the coated substrate and the plate radiates heat upwardly. The substrate is brought up to temperature very rapidly, thus reducing any differences in temperatures between the bottom and top. This action happens so quickly that the glass passes its critical temperature before sufficient thermal strain is built up to crack and craze the substrate. Because of the rapid heating, the entire coated substrate receives the same amount of heat. Uniform loss of chloride is attained and photoluminescence is thus substantially uniform across the entire sintered photoconductor.

The following specific example is offered as a further explanation of the invention, but it is not intended to be limitative upon the claims.

The following ingredients are mixed together and dry mixed by rolling in a bottle for about one hour:

	Gm.
Cadmium sulfide (Phosphor grade)	95.43
Cadmium chloride (reagent grade)	4.39

Copper carbonate (reagent grade)_____ .0578
Ammonium chloride (reagent grade)_____ .0564

The blended material is then fired in a covered No. 3 crucible at 530° C. for a period of 35 minutes and then allowed to cool while covered. When cooled, the cake is removed and crushed to a fairly fine particle size with a porcelain spatula. The powder is placed in a quart mill with 100 ml. of xylene and milled for about 25 hours until a particle size of 1 to 5 microns is attained. After milling, the mill change is removed and the mill is rinsed with 3100 mls. of xylene and the milled suspension is passed through a 200 mesh screen to remove any lumps. The resulting suspension is allowed to settle and all but about 100 mls. of xylene is drawn off and discarded. To the suspension of photoconductor in xylene, 50 mls. of lacquer is added and the suspension is thoroughly stirred. Afterwards the mixture is doctor-bladed on a 4 x 4 inch glass substrate to thicknesses of .001 to .010 inch and allowed to air dry, thus removing much of the organic volatiles and forming a cohesive layer. During these photoconductor preparations, a furnace heated to a temperature of 640° C. and a 3/16 inch thick, 8 x 8 inch metal plate is preheated upon Maranite blocks to that temperature. The plate is quickly removed from the furnace and the coated substrate is placed thereupon. Then the plate is replaced in the furnace to sinter the photoconductor. After heating for 2¼ minutes, the plate is removed and the substrate removed and allowed to cool. Uniform sintering and volatilization was evidenced in all areas on the substrate.

It is apparent that modifications and changes may be made by those skilled in the art, but it is my intention however only to be limited by the scope of the instant claims.

As my invention I claim:

1. In the process for sintering a photoconductor, the steps which comprise: coating said photoconductor upon a substrate; preheating a metal plate, at least as large as the substrate, within a furnace, substantially to the sintering temperature of said photoconductor; placing said coated substrate upon said preheated metal plate and then sintering said coated photoconductor within a furnace.

2. In the process for uniformly sintering a photoconductor including a volatile halide co-activator, the steps which comprise: coating said photoconductor including said volatile halide coactivator upon a glass substrate; preheating a metal plate within a furnace substantially to the sintering temperature of said photoconductor; placing said coated substrate upon said metal plate and heating said coated substrate in a furnace to sinter said photoconductor.

3. In the process for sintering a photoconductor containing a volatile halide co-activator the steps which comprise: coating a glass substrate with a photoconductor having a volatile halide coactivator, said photoconductor selected from the group consisting of cadmium sulfide, cadmium selenide and cadmium selenium sulfide; preheating a metal plate larger than said substrate in a furnace to a temperature within the range of 500 to 700° C.; placing said coated substrate upon said metal plate and sintering said photoconductor by heating to a temperature within the range of 500 to 700° C.

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