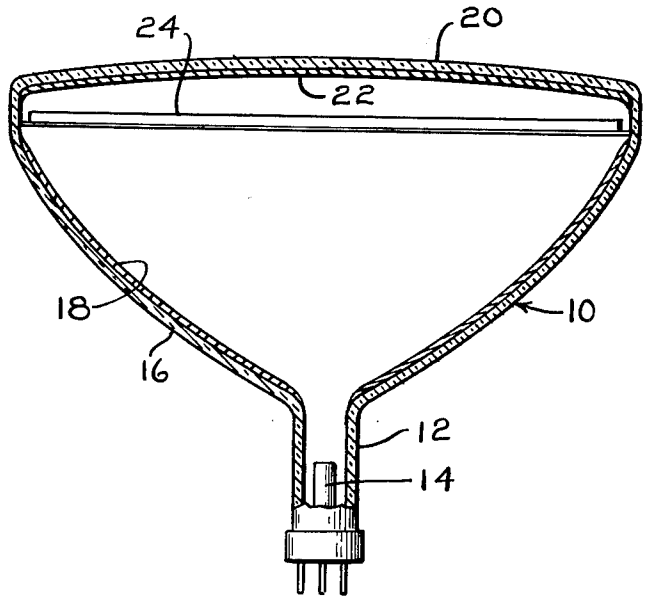
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PREVENTION OF CATHODE POISONING IN AN ELECTRON TUBE

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PREVENTION OF CATHODE POISONING IN AN ELECTRON TUBE

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This invention relates to electron tubes in which a glass component is exposed to electron bombardment during tube operation. It is more particularly concerned with reduction of oxygen evolution from the bombarded glass whereby poisoning of the tube cathode is minimized.

Glass envelopes are widely used in fabrication of electron tubes, particularly the cathode ray tube type. It has been found that glasses generally tend to evolve oxygen when subjected to intense electron bombardment, such as occurs in cathode ray tubes of the type employed for color television reception. Mass spectrometer studies confirming such evolution are described by Todd, Lineweaver and Kerr in an article entitled "Outgassing Caused by Electron Bombardment of Glass" appearing in the Journal of Applied Physics, vol. 31, No. 1, pp. 1–55, January 1960. As indicated in this article, the oxygen evolution may occur both during the electron bombardment and during subsequent thermal treatment of the bombarded glass. Also, glass may be affected either by direct impingement of an electron stream, or by so-called back scattering of electrons onto a tube wall such as occurs from an aperture mask in a color television receiving tube.

In fabricating cathode ray tubes, it is customary to provide an electrically conducting coating over at least a portion of the inside wall or surface of the glass envelope. This coating may serve different purposes, one important function being to provide, within the tube, a substantially field-free region for electron travel from the electron gun to the viewing screen. A variety of conducting coatings, including iridized metal oxide films, have been available for this purpose. However, certain economic and technical disadvantages in other types of coatings have led to commercial adoption of either a baked graphite or an evaporated aluminum type of conducting coating.

Certain difficulties have resulted from using such conducting coatings in cathode ray tubes that employ high values of accelerating voltages. As indicated in the Todd et al. article, a graphite coating may act as an oxygen "getter" under some circumstances, but will itself tend to evolve various gases, including oxygen, under electron bombardment. The well-known heat reflecting properties of an aluminum coating are a distinct disadvantage in tubes having thermally sensitive components, such as the shadow mask type of color television tube. The apparent need to dissipate heat generated within the tube is complicated by the customary practice of aluminizing the viewing screen for light reflection and electrical purposes.

It is a primary purpose of this invention to provide improvements in electron tube manufacture whereby the problems set forth above are avoided or substantially diminished. A particular purpose is to provide a method of reducing oxygen evolution from an electron bombarded glass surface. A further purpose is to provide a glass coating that serves the dual purpose of reducing oxygen evolution from the glass and providing electrical conductivity. A specific purpose is to provide means in a cathode ray tube for minimizing poisoning of an oyxgen-sensitive cathode.

In accomplishing these and other purposes, my invention provides a method of reducing oxygen evolution

from an electron bombarded glass surface which comprises coating the glass surface with a metal oxide film. Preferably the coating is an iridized, electrically conducting film composed of one or more metal oxides. It finds particular application in a cathode ray tube employing an oxygen-sensitive cathode.

The invention is illustrated in, and further described in conjunction with, the accompanying drawing wherein the figure is a schematic representation, largely in section, of a cathode ray tube.

The schematically represented cathode ray tube has a glass envelope **10** composed of a neck portion **12**, a funnel portion **16**, and a face or panel **20**. An electron gun **14** is mounted in the tube neck **12**. An electrically conducting coating **18** is provided on the inner surface of the funnel portion and may extend into the neck. Glass panel **20**, having an aluminized phosphor coating **22** on its internal surface, provides the viewing screen of the tube. Mounted intermediate electron gun **14** and the screen, by any suitable conventional means not specifically shown, is a perforated, or foraminous, mask **24** adapted to selectively transmit portions of an electron beam generated by gun **14**.

In operation, a cathode incorporated in gun **14** emits an electron beam in the direction of the viewing screen. It has been found that certain coatings, particularly certain oxide coatings, enhance electron emission, but are sensitive to the tube gases, particularly oxygen. In the presence of such gases, the cathode coating acts as a "getter" and absorbs the gases, thereby becoming poisoned or less effective as an electron emitter.

In selectively transmitting electrons, perforate mask **24** necessarily intercepts a major portion of the electron stream from gun **14**. Consequently, there is a substantial reflection or back scattering of electrons against funnel **16**. In order to adequately power the tube under such relatively inefficient circumstances, it is customary to employ a considerably higher voltage drop than in an ordinary tube, e.g. 25 or more kilovolts, and a relatively high current density. This in turn augments the effect of electron impingement on the wall of glass funnel **16** as well as increasing the amount of heat generated during tube operation.

Heretofore, the internal surface of funnel **16** would have been provided with a baked graphite or evaporated aluminum coating for purposes of conductivity across the glass surface. In accordance with the present invention, and as shown in exaggerated form for purposes of better illustration, a metal oxide film **18** is applied over the internal surface of funnel **16**. Preferably this film coating is an iridized tin oxide film containing a minor addition of antimony oxide in accordance with the teachings of United States Patent No. 2,564,707 issued to J. M. Mochel.

The exact manner in which such a metal oxide film inhibits oxygen evolution from the glass substrate during and subsequent to electron exposure is not definitely known. The film does, of course, have a finite thickness with respect to electron penetration and thus exerts a degree of stopping power. For this reason, it is desirable that the film be composed of heavy metal oxides and be as thick as is compatible with good glass adhesion and adequate electrical conductivity. Specifically, a film composed of tin and antimony oxides and on the order of 300 millimicrons thick is suited to the purposes.

There is also good evidence to indicate that the metal oxide film either absorbs, or in some other manner hinders release of, oxygen from the underlying glass. This is in the form of comparative mass spectrometer analyses of the amount and composition of gas evolved from glass samples under constant simulated tube operating conditions. The analytical data shows a markedly

lower oxygen evolution from glass surfaces coated with iridized metal oxide films than from corresponding glass surfaces which were coated with electrically conducting layers of baked graphite or evaporated aluminum in accordance with prior commercial tube making practice.

It will be appreciated that only portions of the glass envelope exposed to electron bombardment need be coated with the metal oxide film, although other areas may be covered with the metal oxide film if desired. It is contemplated that an unexposed portion of the tube, such as the internal wall of neck portion **12**, might be coated with graphite which would, in the absence of exposure to electron bombardment, serve as a "getter" for such small amount of oxygen as might be evolved into the tube. Other modifications and variations within the scope of the invention as defined in the appended claims will be apparent to those practicing the invention.

What is claimed is:

1. In an electron tube comprising an oxygen-sensitive cathode and a glass component having an electrically conducting coating, and wherein at least a portion of the glass component is subjected to bombardment by electrons under influence of a high voltage gradient,

the improvement which comprises an electrically conducing metal oxide film adherent to and covering at least that portion of the glass surface subjected to electron bombardment, whereby oxygen evolution due to such bombardment is inhibited.

2. In a cathode ray tube comprising an oxygen-sensitive cathode, a glass envelope and an electron intercepting shield whereby a substantial amount of the electrons emitted by the cathode under the influence of a high voltage gradient are reflected back onto an interior portion of the tube envelope,

the improvement which comprises an electrically conducting metal oxide film adherent to and covering at least that portion of the interior surface of the tube envelope which is subjected to the reflected electrons, whereby oxygen evolution due to such reflected electrons is inhibited.

3. A cathode ray tube in accordance with claim 2 wherein the electrically conducting metal oxide film is composed of tin oxide with a minor addition of antimony oxide.

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