THIN GAS TIGHT WINDOW ASSEMBLY

Samuel I. Taimuty, Palo Alto, Calif., assignor to Stanford Research Institute, Palo Alto, Calif., a corporation of California

Filed Feb. 24, 1964, Ser. No. 346,768
4 Claims. (Cl. 29—185.5)

This invention relates to electron penetrable windows which are gas tight, and more particularly to improvements therein.

The technique of bombardarding an article with electrons for the purpose of sterilizing same is well known. A bombardment by a stream of electrons of a compound for the purpose of producing X-rays for aiding in analysis is also known. The technique of obtaining a stream of electrons outside of a vacuum for purposes such as the above may employ a cathode ray tube having an electron transparent window in the face thereof. Such windows are usually known as Lenard windows.

In order for a Lenard window to withstand the pressure applied thereto by the atmosphere, when it is used in the face of an evacuated cathode ray tube, it must have some substantial thickness.

As a result while the Lenard window is pervious to electrons, the energy which must be applied to the electrons in order to enable them to pass through the Lenard window is considerable. Accelerating voltages on the order of 50,000 volts must be used in the tube or chamber in order to impart such energy to electrons. In view of the high accelerating voltages which are applied, these electron beams are quite stiff, in the sense that it is extremely difficult or impossible to deflect them easily in the manner that cathode ray beams are deflected in the usual cathode ray tube, such as of the type which are used for television picture display. If it were possible to construct a cathode ray tube with a thinner window which can pass low energy electrons, or wherein the cathode ray beam may be deflected with voltages on the order of those normally used in television display devices, then a device would be available which would have far greater use than the mere bombardment of articles for sterilization or chemical analysis. One such use would be to provide a tube which could record electrostatically in accordance with the image forming signals applied thereto, or a tube which could record on film without the necessity for first transforming the electron beam into light, and thereafter recording the light.

An object of this invention is to provide a window for a cathode ray tube which is pervious to electrons having much less energy than has been required for windows of this type before.

Another object of this invention is the provision of a novel method and means for constructing an electron pervious airlock which is also gas tight.

Still another object of the present invention is the provision of a simple and useful method and means for fabricating a thin film barrier that is substantially not permeable by gases or vapors and that can pass low energy electrons.

These and other objects of the present invention may be achieved by first forming a supporting honeycomb structure for the electron pervious thin film. The supporting honeycomb structure may be formed by taking a tube of a first metal, for example, and filling this with a bundle of wires made of a second metal, the sides of the wires being first coated with, for example, the first metal. The whole assembly is then swaged mechanically or explosively. The opposite large surfaces of the assembly are then polished to remove the coating from these surfaces. Then the metal, of which the electron pervious window is to be made, is evaporated, electroplated, or otherwise deposited on one surface of the tube and wire bundle to a desired thickness. The characteristics of the metals which are selected to form the foregoing assembly should be such that only the metal of which the bundle of wires is formed may be etched away chemically, and the other metals should be left unaffected by the etchant. The metal of which the wires are formed is then etched away, leaving the structure consisting of a honeycomb grid of the metal with which the bundle of wires was coated, covered by a thin layer of the thin film metal. If desired, before coating one side of the assembly with the thin film metal, the wires may be etched away and in their place there may be deposited a suitable polymer or sodium silicate. Thereafter the thin film metal may be deposited, after which the polymer or sodium silicate may be dissolved away by a suitable solvent.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

FIGURE 1 illustrates a coated wire of the type which may be employed in accordance with this invention;

FIGURE 2 shows a tube filled with wires of the type shown in FIGURE 1;

FIGURE 3 shows an enlarged cross sectional view of a thin film window in accordance with this invention, and;

FIGURE 4 shows the appearance of a thin film window made in accordance with this invention, mounted in the face of a cathode ray tube.

In order to make a thin, gas tight window in accordance with this invention, the first step is to fabricate a supporting grid. This may be manufactured by first making a bundle of wires, one of which is represented in FIGURE 1, and coating each one of these wires with a metal 12. Each of the wires 10 may be made of aluminum and coated for example with copper.

As shown in FIGURE 2 a tube 14, which may be made of the same metal, copper, as the coating on the wires 10, is filled with these wires and the whole assembly is then swaged, mechanically or explosively. The assembly may then be cut to have a desired thickness and the surfaces of this assembly are then polished for flatness and to remove the coating metal from these surfaces.

A thin film of a material, such as a metal, from which it is desired to form the thin film window, is then deposited either by evaporation, electroplating, or otherwise, on one surface of the assembly to a desired thickness. This can be less than 1,000 angstroms thick with the thickness being dependent on the diameter of the grid holes.

The properties of the respective metals of which the bundle of wires, the coating thereon, the tube containing the wire bundle, and the thin film window, should be such that the metal forming the wires may be etched away chemically leaving the other metals substantially unaffected by the etchant. Thus, as a next step in the process of manufacture, the aluminum wires may be dissolved away by a suitable etchant or solvent, leaving a cellular or honeycomb grid of the coatings of the wires, which grid structure is covered on one side by a thin layer of the thin film window metal. A cross section therefrom would have the appearance shown in FIGURE 3 with the thin film window 16 being on one side of and supported by a grid 18 with the grid being anchored to the support ring 14.

As shown in FIGURE 4 the assembly may be mounted in the face of a cathode ray tube 20. An electron beam may then penetrate the thin film window 16 with energies...
on the order of 10,000 electron volts for example. A cathode ray beam containing such low energy electrons may be easily deflected with deflection voltages on the order of those employed for the average television picture presentation tube. Therefore, it is a simple matter to apply video signals to a cathode ray tube of the type 20, which can then be recorded directly by bombardment with electrons on film passed across the face of the tube, or can produce electrostatic charges on a suitable electrostatic writing medium passed by the front of the tube. Alternatively, a device of the sort described may be employed for bombarding mixtures, which it is desired to analyze, by means of low energy X-rays resulting from the low energy bombardment of these materials. When used for electrostatic printing, the honeycomb structure should not appear on the finished copy due to divergence of the electron beam after passing through the window.

In the description given above, the metal which is employed for the thin film window may be the same as the metal employed for forming the supporting coatings, i.e., copper, but is not required to be so. It may be a metal which can be oxidized by anodic method or some other suitable method. After deposition of a layer of the thin film window metal on the base structure, this metal may be completely oxidized. Thereafter the wires may be etched away leaving a structure consisting of a grid structure covered by a thin layer of oxidized metal. Such a grid may be an insulator (for example aluminum oxide or tantalum oxide). It may be transparent to light (for example aluminum oxide). This thin film window may also be a semiconductor (for example tin oxide). Alternatively, the insulating film window may thereafter be made conducting by evaporating a 50 angstrom thick layer of metal (for example aluminum) on the outside surface.

In the event that it is desired to make the thin film window of the same material as that of the wires which are dissolved away, then after the construction of the swaged tube and wire bundle has been completed and polished and before deposition of the window material on one surface thereof, the wires may be etched out leaving behind a honeycomb of their coatings supported by the surrounding tube. The openings in the honeycomb may then be filled with a suitable polymer (polystyrene for example or an epoxy resin) or sodium silicate, or some other support material which can be dissolved without affecting the material of the window or the material of the honeycomb. Thereafter the surface provided be polished, the material of the window can then be deposited, and the material filling the holes in the honeycomb can thereafter be dissolved away by a suitable solvent that does not attack the materials of the window or the honeycomb.

It may be possible to purchase honeycombs or grids of the type described. In this event, the above-described method may be used for forming a thin film window. That is the holes in the grid are filled as above, the surface provided is polished, the film deposited on this substrate, and the hole filling material is removed.

It may be desirable to have a thin film window in which a portion of this film is insulating and a portion of the surface of the thin film is conducting. Those skilled in the art will appreciate that this can be done by either depositing a thin metal film of a material such as aluminum which can thereafter be anodized and thereafter a conductive coating be deposited on the outer surface thereof, or a partial anodization of the deposited metal may be resorted to.

In accordance with the foregoing, there has been described and shown therein a novel and useful thin film assembly which is pervious to low energy electrons and is not permeable by gases or vapors. This thin film will support a pressure at least on the order of atmospheric pressures and thus may be employed as the window in a vacuum window for a thin film may be insulating, semi-conducting or conducting as described. The window also may be opaque or transparent as preferred. While the form of the window is shown as circular, this should not be construed as a limitation, since it may easily be made to have other geometrical forms as well.

I claim:

1. A method of making a thin film electron pervious window comprising coating wires made of a first metal soluble in a solvent with a thin film of a second metal not soluble in said solvent, compacting a bundle of said wires, polishing an end surface of said bundle, to establish a smooth surface with the ends of wires in said bundle, dissolving out said first metal with said solvent leaving a cellular like grid of said second metal, filling the holes of said cellular like grid with a material which is soluble in a second solvent in which said first and second metals are not soluble, depositing on said polished surface a film of said first metal to a desired thickness, and dissolving said material out of said cellular grid with said second solvent.

2. A method of making a thin film electron pervious window as recited in claim 1 wherein, after the step of compacting said bundle of wires there is included the step of cutting a transverse slice thereof to provide an end surface of said bundle, which is polished.

3. A method of making a thin film electron pervious window comprising coating wires made of a first metal soluble in a solvent with a thin film of a second metal not soluble in said solvent, compacting a bundle of said wires, polishing an end surface of said bundle to establish a smooth surface with the ends of wires in said bundle, dissolving out said first metal with said solvent leaving a cellular like grid of said second metal, filling the holes of said cellular like grid with a material which is soluble in a second solvent in which said second metal is insoluble, depositing an anodized metal film insoluble in said second solvent on said polished surface to a coating thickness which is permeable by low energy electrons, and dissolving said material out of said cellular grid with said second solvent.

4. A method of making a thin film electron pervious window as recited in claim 3 wherein said step of depositing an anodized metal film on said polished surface includes the steps of depositing a film of an anodizable metal on said polished surface to a coating thickness permeable by low energy electrons, and anodizing said film of anodizable metal.

References Cited by the Examiner

UNITED STATES PATENTS

1,907,507 3/1937 Coolidge ------------- 313—74
2,499,977 3/1950 Scott ------------- 29—163.5
2,619,438 11/1952 Varian ----------- 29—423 X
2,721,952 10/1955 Kenyon ---------- 29—2511 X
2,752,662 7/1956 Crooks.

JOHN F. CAMPBELL, Primary Examiner.
WILLIAM I. BROOKS, Examiner.