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L. E. CHEESMAN ET AL
SECONDARY ELECTRON EMITTER

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FIG. 1

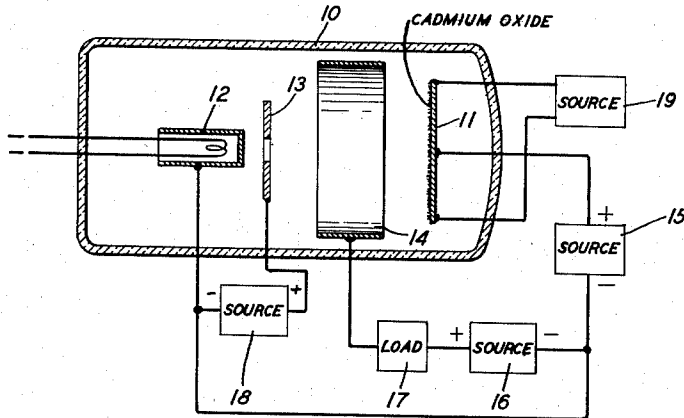
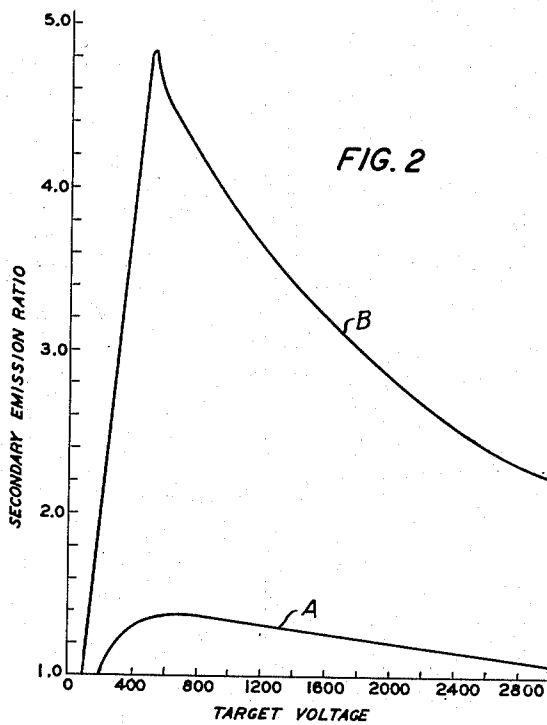


FIG. 2



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SECONDARY ELECTRON EMITTER

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7 Claims. (Cl. 250-174)

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This invention relates to secondary electron emitters and to methods of making such emitters.

One object of the invention is to obtain enhanced secondary emission from targets in electron discharge devices. More particularly, one object of this invention is to obtain a stable, readily fabricated target having a large secondary emission ratio at relatively low primary electron or target voltages.

The invention involves the discovery that cadmium oxide, which normally has an emission ratio of the order of unity even at primary electron voltages of several thousand volts, can be activated to have a large ratio at low voltages.

In one illustrative embodiment of this invention, a target electrode for electron discharge devices comprises a film of cadmium oxide, of the order of 5,000 angstroms thick, upon a base of commercially pure platinum. The oxide is activated by heating the film-base unit for a prolonged time, whereby the emission ratio of the oxide is greatly enhanced. For example, in one exemplary construction, after heating of the unit at about 800° C. for about 22 hours, emission ratios of the order of 4.8 at a primary voltage of 500 volts are attainable for the oxide.

The invention and the features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing, in which:

Fig. 1 is a diagram of an electron discharge device illustrative of those in which secondary electron emitters constructed in accordance with this invention may be utilized; and

Fig. 2 is a graph showing the relation between the secondary electron emission ratio and primary electron voltage, for a target electrode illustrative of one embodiment of this invention.

Referring now to the drawing, the electron discharge device illustrated in Fig. 1 comprises a highly evacuated enclosing vessel 10 having therein a target electrode 11 and an electron gun for projecting an electron stream to and against the target electrode. For simplicity of illustration, the electron gun has been shown as comprising an indirectly heated cathode 12 and accelerating electrode 13, it being understood that any one of a number of conventional gun constructions may be employed such as guns including tungsten or thoriated tungsten filamentary type cathodes. Opposite the target electrode 11 is a collector electrode 14, for example cylindrical as shown, for receiving secondary electrons emanating from the target electrode 11.

The target electrode is maintained at a positive

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potential relative to the gun by a direct-current source 15, the potential being variable, if desired, to control the energy of the primary electrons impinging upon the target electrode. The latter is biased negative relative to the collector electrode 14 by a direct-current source 16. An output or load element 17 is connected between the target and collector electrodes as shown. The electrode 13 is biased positive relative to the cathode by a source 18.

The target electrode 11 comprises a commercially pure platinum base having on the face thereof toward the electron gun a layer or film of cadmium oxide. Such a layer or film may be produced in one way by cathodic sputtering of cadmium upon the base, operated as the anode, in an oxidizing atmosphere. In an illustrative case, a film of the order of 5,000-angstrom units thick may be deposited in about four hours by cathodic sputtering from a flat spiral cadmium rod spaced about two inches from the platinum base, and in a partial vacuum such that with a direct-current voltage of 400 volts applied between the cathode and anode through a 5,000-ohm ballast resistance the cathode dark space of the discharge extends to within about one-half inch from the base to be coated. After the base has been coated, the composite unit may be heated in a hydrogen oven at 200° C. for about two hours whereby an increase in the conductivity of the coating is realized.

The secondary emission characteristics of cadmium oxide treated in accordance with this invention will be appreciated from Fig. 2. In this figure, curve A depicts the secondary emission-primary electron voltage relation at room temperature for a target electrode constructed as described above, the cadmium oxide coating being of the order of 5,000 angstroms thick and the base being of commercially pure platinum. As is evident, the secondary emission ratio is quite low, having a maximum value of about 1.4 at a bombarding voltage of about 600 volts. It has been determined that with the target maintained at temperatures up to 700° C., by passing heating current therethrough from a source 19 as illustrated in Fig. 1, the secondary emission ratio is uniformly low, the maximum obtained being somewhat above 2.

However, when the target electrode is heated to about 800° C. the secondary emission ratio increases suddenly. Curve B in Fig. 2 shows the secondary emission characteristics of the target, at room temperature, after the target had been heated at 800° C. for 21 hours and then at 900° C.

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for one hour. The maximum secondary emission ratio, it will be noted, is about 4.8 at a primary electron voltage of about 500 volts.

Although the invention is not to be limited thereby, the following explanation is thought to account for the enhanced secondary emission of the cadmium oxide film obtained by heating the target. The temperature, about 300° C., of treatment at which a marked secondary emission enhancement obtains is about that at which, in vacuum, cadmium oxide begins to break down to release cadmium. The cadmium atoms thus released activate the oxide film. Furthermore, commercially pure platinum contains minute quantities of impurities of the order of magnitude indicated below.

	Per cent
Tin and palladium.....	0.01 to 0.3
Copper.....	less than 0.03
Gold, iron, manganese, nickel and lead	less than 0.005
Barium, magnesium and silicon.....	less than 0.001

These impurities, during the heating of the target, diffuse into the cadmium oxide, and also activate the oxide coating.

Chemically pure platinum contains, generally, these same impurities but in amounts an order of magnitude less than in commercially pure platinum.

Although a specific embodiment of the invention has been shown and described, it will be understood that it is but illustrative and that various modifications may be made therein without departing from the scope and spirit of this invention.

What is claimed is:

1. The method of making a secondary electron emitter which comprises applying a layer of cad-

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mium oxide to a base, and heating the composite body thus formed at a temperature of about 800° C.

2. The method of making a secondary electron emitter which comprises applying a film of cadmium oxide to a base of platinum containing impurities, and heating the composite body thus formed at a temperature of the order of 800° C.

3. The method of making a secondary electron emitter which comprises applying to a base of commercially pure platinum a layer of cadmium oxide, of the order of 5,000 angstroms thick, and heating the composite body thus formed at a temperature of about 800° C. for about 21 hours.

4. The method defined in claim 3 comprising further heating said body at a temperature of about 900° C. for approximately one hour.

5. A secondary electron emissive target for electron discharge devices comprising a base having thereon a film of cadmium oxide.

6. A secondary electron emissive target for electron discharge devices comprising a base of commercially pure platinum having thereon a film of cadmium oxide, the base-oxide body having been heated at a temperature of the order of 800° C.

7. A secondary electron emissive target for electron discharge devices comprising a base of commercially pure platinum having thereon a film of cadmium oxide of the order of 5,000 angstroms thick, the base-oxide body having been heated at a temperature of about 800° C. for approximately 21 hours and at a temperature of about 900° C. for approximately one hour.

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No references cited.