A novel fabrication method of the Y-Gd-Hf-O W base directly-heated cathode

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ABSTRACT

As the heart of the vacuum tubes, cathode plays an important role in the device. During the operating process of a magnetron, cathode is continuously bombarded by electrons because of the electromagnetic field effect [1,2]. The higher the magnetron output power, the greater the bombardment of electrons to cathode. So, in the high power continuous magnetrons, the cathode must have a strong anti-electron-bombardment capability besides high current density at operating temperature. The Y-Gd-Hf-O impregnated W base cathode prepared by tradition method is one of the high emission current density direct-heated cathodes [3], but its anti-electron-bombardment capability is weak when it's applied in the high power continuous magnetrons. In this abstract, a novel manufacture procedure for the Y-Gd-Hf-O impregnated W base cathode is presented.

The cathode emission materials, consist of the proportional Y_2O_3, Gd_2O_3, HfO_2 powders with a purity of 99.9% and a diameter of 2-10μm, were mixed in an agate jar. Then, the mixed powders were pressed into pellets and sintered in a muffle furnace at 1400℃±50℃ to complete the preparation of the Y-Gd-Hf-O emission materials. Then the Y-Gd-Hf-O emission materials and Sc_2O_3 (5%wt) were mixed and ground well mechanically [4]. The polyporous W base, including Re-W strip (0.3mm×0.2mm) base and W sponge coating, was sintered in dry hydrogen atmosphere at about 1200±50℃ for 10 minutes. After that, the emission material was spread on the W base surface with a special mould and pressed by a hydraulic machine with the pressure of 100N/cm^2. Finally, the W-Re base Y-Gd-Hf-O impregnated cathode was sintered in the hydrogen furnace at 1500±50℃ for 3~5 minutes.

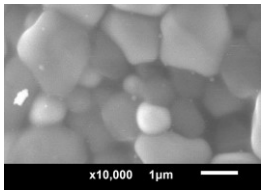

Fig.1 SEM of the Y-Gd-Hf-O W base cathode prepared by the novel fabrication method

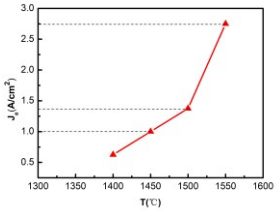

Fig.2 Emission characteristic at different temperature

The SEM observation was performed on the cathode surface. It's noticed that (Fig.1) the particle diameter of the powder is less than 5μm and the sub-micro structure is seen clearly. Furthermore, there are few pores in the material in micro-structure and it means that a cermet phase has been formed in the macrostructure, which indicates the cathode has a better resistance to the electron bombard compared with traditional Y-Gd-Hf-O cathode.

The cathode emission testing results (Fig.2) have shown that dc emission current density can reach to 1A/cm^2 at 1450°C, 1.38A/cm^2 at 1500°C and 2.75A/cm^2 at 1550°C under 220V. The testing for the anti-electron-bombardment capability of the cathode is under way.

References

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