

Recent advance in dispenser cathode

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As the electron source of vacuum electron devices, the performance of cathodes plays an important role in the device stability and operational durability. In recent years, we made a serial studies on the mixed matrix of Ir-W scandate cathodes, introduction of inert barrier layer Ni in the dispenser cathode, optimizing the composition of barium-calcium aluminates[[1-3]. In order to improve the emission property, a new BaO-CaO-Al₂O₃-BaF₂ quaternary aluminate impregnant was obtained and the addition of BaF₂ decreases the viscosity and melting point of the aluminate impregnants. The emission current density of Ba-W cathode impregnated with quaternary aluminate impregnant can reach 15.89 A·cm⁻² at 1100°C_b, which is 1.11 times higher than that of the without BaF₂. Theoretical calculations confirm that introducing fluorine triggers the number of point defects and barium compound in impregnant to gain electron convert to the metastable Ba^{δ+} (0 < δ < 2), enhancing the ability to produce active substance Ba. The introduction of Ni can inhibit the reaction between W and Ba-Ca-aluminates during the impregnation process of the matrix. After cathode activation, the surface Ba:O ratio is 0.88:1.00, much higher than the Ba dispenser cathode without Ni doping. The pulse electron emission current density at 1100°C_b was 18.65 A/cm². It has a low evaporation rate and the accelerated lifetime test predict a lifetime of over 160000 hours. W-Ir matrix scandate cathode presented the highest emission current density of 83.43 A/cm² at 900 °C_b. Ir can decrease the evaporation of active substance, effectively stabilizes the W-O-Ba-Sc surface configuration, and therefore significantly enhances the emission property of the cathode.

Reference

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