

# High Temperature Brazing Using Co Based Alloy Filler for Scandia Doped Dispenser Cathode Application

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## ABSTRACT

With the rapid development of the Scandia doped tungsten matrix cathode in recent years, the demands of the studies on the applications of the cathodes have increased accordingly. [1] The welding of this cathode during assembling with the molybdenum sleeves is an important procedure for cathode component manufacturing, [2] where the solder plays an essential role. In this study, a new kind of Co-W-Mo ternary alloy filler was developed. The Co-W-Mo ternary alloy filler and Co-W/Co-Mo binary alloy powder filler are prepared by slurry mixing combined with  $H_2$  reduction. The experiment results demonstrate that the melting points of the solders can be adjusted by the concentration of W and Mo in the solder from 1350°C to 1495°C. The joint section of the cathode and sleeve using the Co-W-Mo ternary solder was observed, as shown in Fig.1. It indicates that the solder has good wettability to W and Mo. By analyzing the composition at the brazing interface, it is found that the reaction between solder and W\Mo can take place with the phase transition from  $Co_3W/Co_3Mo$  to  $Co_7W_6/Co_7Mo_6$  during brazing. Meanwhile, the DFT calculations are carried out to evaluate the mechanical properties of  $Co_3W/Mo$  and  $Co_7W/Mo_6$ . The result indicates that the new compound  $Co_7W/Mo_6$  enhance the strength of the Co-W/Mo alloy significantly. To further study the potential influences of solder to the emission capacities of cathode, the assembled cathode is tested and aged in a high vacuum diode system. The V-I curves measured at pulse condition indicate that the performance of cathode keeps almost the same by comparison to that assembled by laser welding method. Moreover, the Auger electron spectrum analysis indicates that Co has not diffused to the surface of the cathode during operating and even after being aged at 1200°C<sub>b</sub> for hundred hours. Therefore, the Co-W/Mo ternary alloy is suitable for the brazing of scandia doped tungsten matrix cathode.

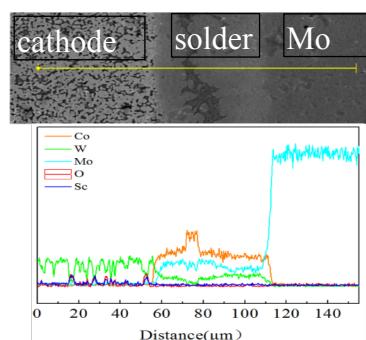


Fig.1 Cross-section SEM and element analysis of the joint section of  $Sc_2O_3$  doped tungsten matrix cathode and molybdenum sleeve after brazing

## References

- [1] Yang Y, Wang Y, Liu W, et al., IEEE Trans on Elec Dev, 2018, 65(6): 2072-2076.
- [2] Busbaher D, Liu W, Sekulic D P. in Proceedings of the 2010 IEEE International Vacuum Electronics Conference (Monterey, CA, USA, 2010). p.151