

Preparation for New Dispenser Cathode's Active Substance Using Freeze-Drying Method

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ABSTRACT

Previously we introduced a new impregnated dispenser cathode whose active substance combines scandate-doped barium aluminate with SrO, and it reached a pulse current density of $171.6 \pm 2.8 \text{ A/cm}^2$ at $1100^\circ\text{C}_\text{B}$ in test [1]. However, due to the inhomogeneity in solid-phase mechanical grinding and mixing of ingredients, the cathodes performed inconsistently at times. Thus, we put forward a liquid-phase way of synthesis, namely freeze sublimation method, to improve the material's homogeneity and cathodes' emission performance as well as its consistency.

The raw materials are acetates or nitrates of Ba, Sr, Al and Sc. They were made into water solution at specific ratios. After adequate stirring, the solution was cooled by liquid nitrogen for instant freezing and then put into a vacuum freeze-drying machine to let water evaporate sufficiently. Dry precursor powder was calcined and then impregnated into porous tungsten matrix at 1750°C , both in hydrogen atmosphere. Emission tests were carried out using the same configuration as [1]. After activation at $1150^\circ\text{C}_\text{B}$, the cathodes reached 670 A/cm^2 , approximately 4 times of that of [1] with good consistency between 2 samples. EDAX results demonstrate that the elementary compositions keep uniform in random areas of the powder of the active substance. XRD patterns (Fig.2) demonstrate that the main phase of calcined precursor is mainly $\text{Ba}_2\text{ScAlO}_5$ with 3at% SrO, which is a novel component in scandate cathodes [2]. Further duration tests, investigations and characterizations like PEEM/TEEM and AES are to be done.

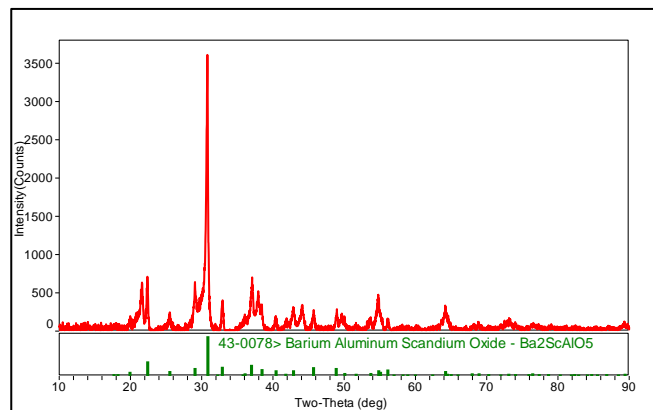
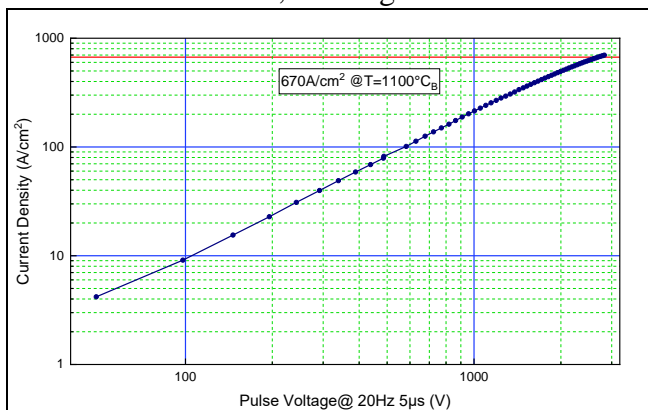


Fig.1 (left) Cathode's pulse emission curve of one of the recipes at $1100^\circ\text{C}_\text{B}$.

Fig.2 (right) XRD pattern of major phase of precursor after calcination.

References

- [1] Shengyi Yin, Zhaochuan Zhang, et al., IEEE Transactions on Electron Devices, (2013) 4258.
- [2] Wei Liu, Ke Zhang, et al., Applied Surface Science, 251.80-88.

Poster Presentation