

EVOLUTION OF M-TYPE CATHODE EMISSION DURING LONG-TERM LIFE-TESTS

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ABSTRACT

Numerous models have been proposed to predict the lifetime of thermionic cathodes [1-5], yet long-term experimental validation remains scarce, particularly over multi-decade timescales. In this work, the long-term evolution of the zero-field saturation current density of multiple M-type impregnated cathodes was investigated over four decades. The cathodes, impregnated with Ba–Ca aluminate (4:1:1) and coated with an osmium–ruthenium layer, were mounted in dedicated bulbs and operated in diode configuration at a current density of 1.5 A/cm² across a range of temperatures (970-1030°C). Periodic measurements of J_0 reveal a clear and systematic degradation of the emission over time.

Complementary analyses of end-of-life cathodes by SEM, Auger spectroscopy, and XPS provide insight into the underlying ageing mechanisms. The experimental results show good agreement with the semi-empirical life prediction model proposed by Schroff [2]. Altogether, these results provide a consistent framework for understanding cathode ageing and contribute to improved lifetime prediction in thermionic devices.

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