Work function of dispenser cathodes and life prediction model

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ABSTRACT

TAVS uses dispenser cathodes as electron sources in a large variety of RF and microwaves tubes (TWT's, Klystrons, Gyrotrons) covering different applications: ground-based (uplink) and space-based (downlink) telecommunications, radars, electronic counter-measures, high-tech scientific applications, radiotherapy and medical accelerators. The performance in terms of electronic emission of a thermionic cathode is characterized by its work function φ. The knowledge of the emission capability of the cathodes is of primary importance to first, master the manufacture of the tubes, and second, ensure the lifetime requested by the aimed application. The value of the work function can be obtained through a theoretical calculation [1], or deduced experimentally by performing the so-called Schottky plots. A semi-empirical model developed by Shroff *et al.* [2] and Dieumegard *et al.* [3] has provided the values of the coefficients involved in the calculation of the work function. This model comes in complement to Longo's model predicting the cathode lifetime [4]. Auger Electron Spectroscopy [5], [6], [7] reveals the combined presence of O and Ba in the form of a top monolayer on the emitting face of the cathode. The degree of coverage θ of the cathode surface by this top layer is the key factor entering in the calculation of the work function. The estimation of the evolution of θ as a function of the cathode ageing allows calculating the cathode lifetime. Recent characterizations of M-type cathodes including long life test results allow comparing the evolution of the measured cathode emission and associated φ with the calculated ones. Through measurements and model, the reliability of these cathodes is demonstrated.

References

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