Qualification of M-type cathode up to 4 A/cm² for space applications

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ABSTRACT

To obtain ever more powerful space TWT in particular in Q-band, cathode technology and models are constantly improved. Based on Thales in-orbit heritage with the M-type cathode up to 2.6 A/cm², we develop in this presentation a new approach based on time-to-knee measurement to adjust the operating cathode temperature. This cathode temperature adjustment method guarantees that the cathode can safely operate at 4 A/cm² for a space mission with a lifetime exceeding 15 years.
Two temperature constraints have to be managed to insure lifetime and reliability:

- The hotter the cathode, the shorter its lifetime. The electron emission decays when the cathode ages and this effect is compensated by increasing the anode voltage [1]. As shown in the figure, cathode temperature needs to remain below the 15 years line.
- The cathode has to emit enough current. Thales heritage shows that a good safety margin is defined with at least a factor 2 between J0 (saturation current density) and Jn (nominal current density) at the operating temperature Tk at the beginning of life. Operation close to J0 results in reduced quality of the electron beam. The corresponding line J0 (TK) = 2 Jn = 8A /cm² is shown on the same graph and cathode must therefore operate above this line.

The space between these two lines shows that a M-type cathode can successfully fulfil its mission even with a spread on the initial J0 and the temperature. The typical operating temperature of 990°CB enables a lifetime exceeding 18 years at 4 A/cm².
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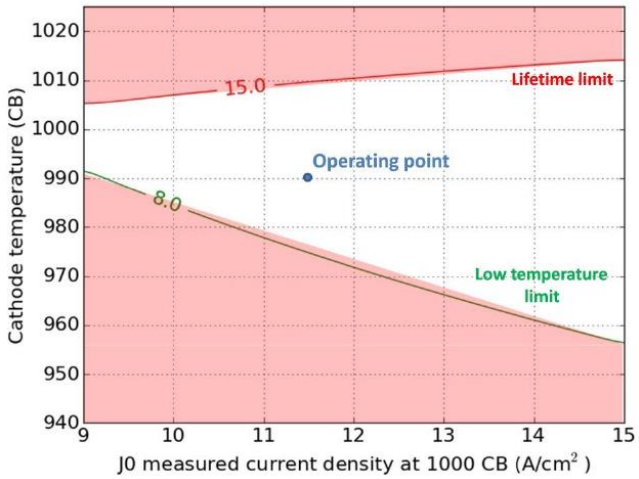

References

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