TB-128

Notes on Dispenser and Oxide Cathodes

Tungsten Dispenser

The dispenser cathode consists of a porous tungsten matrix that is impregnated with a mix of Barium Calcium Aluminate. After installation into a tube, it is activated by heating to produce high emission properties.

- Can be let up to air and reactivated repeatedly.
- More tolerant to poisoning.
- Manufacturing control is less rigid. Reproducibility is well proven.
- Easier to handle, no delicate coatings to be concerned with.
- 3 A/cm2 or more CW. >40,000 hours lifetime in many applications at higher loadings than oxide cathodes.
- 900-1200°C operation.
- Smaller cathode area possible due to higher emission capabilities. This can result in lower heating power requirements.
- Can be made with a potted heater. More tolerant to vibration and more efficient than a free standing heater. Many heater styles available and include fast warm-up and low noise applications.
- R&D continues on dispenser cathodes.
- Osmium Ruthenium coatings (M Type) available for lower temperature operation at a given current requirement.
- Scandium oxide impregnant is available for higher emission capabilities at lower temperatures. The Stanford Linear Accelerator (SLAC) has 8 A/cm2 for over 45,000 hours.

Oxide

An oxide cathode consists of a nickel substrate that is overcoated with a carbonate mixture. After installation into a tube, it is activated by heating to convert the carbonates into oxides.

- Typically operates at a lower temperature than a dispenser cathode. (800-925°C)
- Cannot be reprocessed after exposure to air.
- For a given emitter area, requires less heating power than a dispenser cathode at a given current density. Typically uses a free standing heater. Shock and vibration sensitive.
- Lower cost when comparing emitters only.
- 500 mA/cm2 maximum CW emission.
- Pulse operation up to 100 amps/cm2 depending on pulse length, duty and lifetime requirements.
- Strict manufacturing controls are a must since the cathode coating process is very critical and difficult to reproduce. Density, texture and spraying techniques are all critical.
- Coating is fragile and is very susceptible to loss of emission by erosion from ion bombardment, adherence to the substrate, arcing and changes in its environment.
- Much easier to poison.
- R&D funding is minimal and development has reached a plateau.

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