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On the life expectance of high-power CW magnetrons for SRF accelerators

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Modern CW or pulsed Superconducting RF (SRF) accelerators require efficient RF sources controllable in phase and power with a reduced cost. Therefore, utilization of the high-power CW magnetrons as RF sources in SRF accelerator projects was proposed in a number of works. But typically, the CW magnetrons are designed as RF sources for industrial heating, and the lifetime of the tubes is not the first priority as it is required for high-energy accelerators. The high-power industrial CW magnetrons use the cathodes made of pure tungsten. The emission properties of the tungsten cathodes are not deteriorated much by electron and ion bombardments, but the latter causes sputtering of the cathode in the magnetron crossed fields. The sputtered cathode material covers the magnetron interior. That lead to sparks and discharges limiting magnetrons lifetime. We considered an analysis of magnetron failure modes vs. output power, developed a model of ionization of the residual gas in the magnetrons interaction space and simulated the spattering of the cathode in 100 kW CW magnetrons to estimate the life expectancy. Basing on results we proposed ways to increase the CW magnetrons longevity for SRF accelerators.

Footnotes

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