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ELECTRONIC EMISSION OF A COLD VELVET CATHODE IN MULTI-PULSE REGIME

Abstract

Linear Induction Accelerator (LIA) Flash X-ray radiography uses electron beams, produced by an injector, accelerated and focused on a high Z material target. Spot size of the focused beam strongly depends on its emittance, and so, depends on the emittance of the injector's beam.
The electronic emission of velvet cathodes is well modelized in the single pulse regime. In the context of the development of an injector which can deliver several successive pulses in the microsecond range, experimental work is necessary to improve the understanding of the electronic emission phenomenon. The objective is also to estimate the emittance measurements based on beam Cerenkov images.
Experiments are realized with the dual-pulse generator Mi2, developed at CEA CESTA for multi-pulse Flash X-ray radiography applications. Two pulses (700 kV, 2-3 kA, 60 ns) are applied on a cold velvet cathode and thus generate two electron beams.

Discussion

It is assumed that the emittance increases with the inhomogeneity of the emission surface.
Previous experiments, conducted with a single camera collecting the light produced by Cerenkov Effect (capturing either the first or the second beam) showed a variation in the homogeneity of the beam current density. By improving our understanding of the lectronic emission of velvet cathode, we intend to understand these variations.
Cerenkov and optical imaging [1] have shown a spotty emission profile. In parallel to the experiments, simulations are then carried out. Mi2's diode geometry in 2D (cylindrical space) was simulated with the particle beam simulation software LSP (Large Scale Plasma).
Different inhomogeneous emission surfaces are tested in order to determine the influence of those parameters on the beam emittance: recess, electron emission temperature, discontinuous emission surface, spotty profile, cathode geometry with pads of different width, height and spacing.
The aim is to identify configurations that produce beam profiles similar to those observed by Cerenkov imaging. By this means, we intend to :

- formulate hypotheses on the electronic emission mechanisms of velvet cathodes and on the reasons for the variation of the current density homogeneity between the first and the second pulse
- develop accurate simulation models
- estimate the beam emittance value at the cathode by observation of Cerenkov images.

References

[1] TL Houck *et al.* LLNL-TR-605934
"Determining beam quality by cathode plasma image analysis"