

## Research of Intrinsic Emittance of Thermal Cathode with Emission Nonuniformity

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**Abstract :** The thermal cathode is widely used in accelerators, FELs and kinds of vacuum electronics. However, emission nonuniformity exists due to surface profile, material distribution, temperature variation, crystal orientation, etc., which will cause intrinsic emittance growth, brightness decline, envelope size augment, device performance deterioration or even failure. To understand how emittance is manipulated by emission nonuniformity, an intrinsic emittance model consisting of contributions from macro and micro surface nonuniformity is developed analytically based on general thermal emission model at temperature limited regime according to a real 3mm cathode. The model shows relative emittance increased about 50% due to temperature variation, and less than 5% from several kinds of micro surface nonuniformity which is much smaller than other research. Otherwise, we also calculated emittance growth combining with Monte Carlo method and PIC simulation, experiments of emission uniformity and emittance measurement are going to be carried out separately.

**Keywords :** thermal cathode, electron emission fluctuation, intrinsic emittance, surface nonuniformity, cathode lifetime

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