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## New field emission dynamics in a 2D space charge dominated regime beyond Fowler Nordheim for high gradient injectors

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The work presented here shows evidence of the diversions from classical Fowler Nordheim in the RF regime. At high gradients in excess of 100 MV/m, it was shown that the field emitter cathode (FECs) made from ultranocrystalline diamond (UNCD) follows a two-dimensional space charge dominated regime. Field emission dynamics now must be considered in a 2D regime, combining the 1D longitudinal classical Fowler Nordheim and 1D transverse Child Langmuir limit. These cathodes were able to produce remarkably high charge of 300 nC/6  $\mu$ s pulse giving a beam current of 0.12 A. This cathode produced uniform emission with effective emission area of tens of microns which is three orders of magnitude higher than predicted by classical Fowler Nordheim. To explore this new n-dimensional space charge dominated field emission physics, we present the design of a new X-band field emission rf gun.

### Topic

Field Emission

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