SIEMENS

CARBON FIELD EMISSION STRIP CATHODE ELECTRON SOURCE

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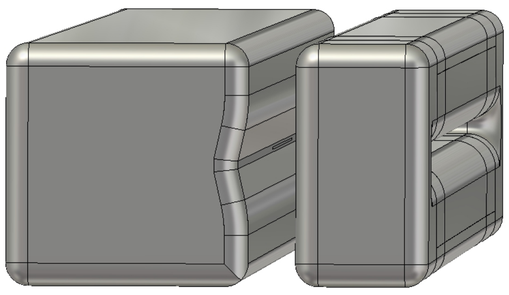
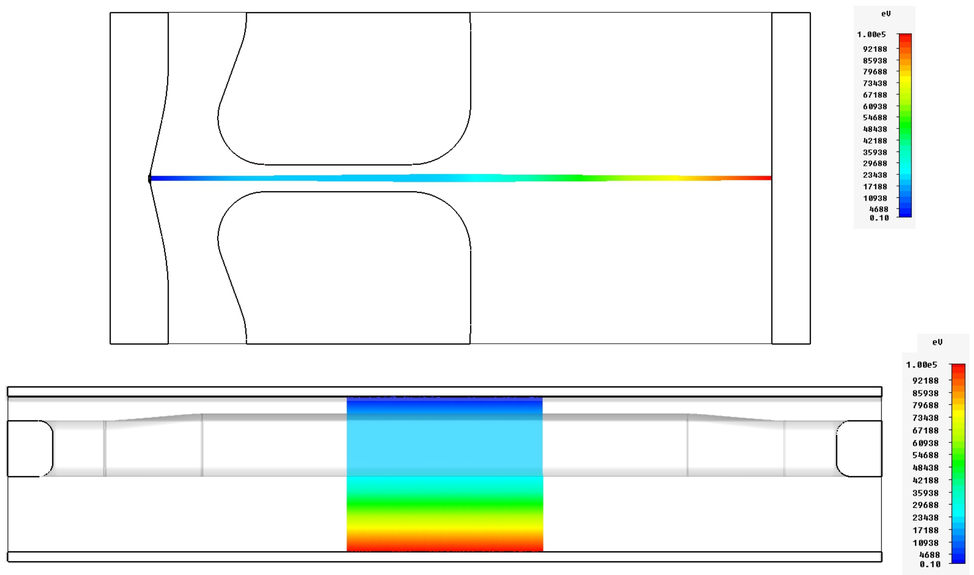


Triode field emission unit model



Electron beam trajectory (side view)

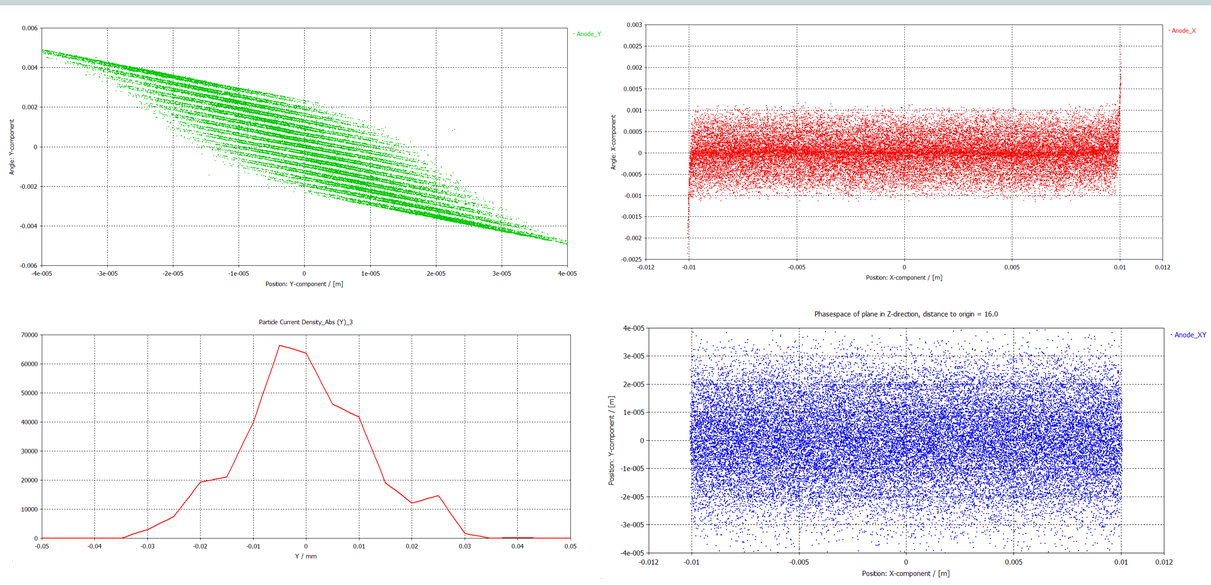
Quick description

The article is concerned with the experimental unit for investigation of the carbon nanostructure field emission cathodes. The presented results are the electron beam dynamics investigation of the strip-shaped triode system and construction of the experimental setup elements.

The electrons are focused 1:2 along vertical axis. While along a narrow cathode side the focusing electrical field is applied to electrons, along the broad side there is no transverse electrical field presented. Strip shape of the cathode was chosen to get more information about the initial parameters of the electrons emitted from the cathode surface.

The investigated parameters in the setup are: cathode VI-characteristics and anode focal spot dimensions. The measurement of the anode X-ray focal spot will be processed with pinhole technique, triode broad side is tilted <10 degrees with a goniometer to decrease the broad size of the focal spot. The triode unit is mounted inside the vacuum chamber with foreseen high-volage feedthroughs, multi-pin feedthrough and Be window.

The experimental setup is now under construction. The first results of the measurements are foreseen to be acquired in the late 2014.



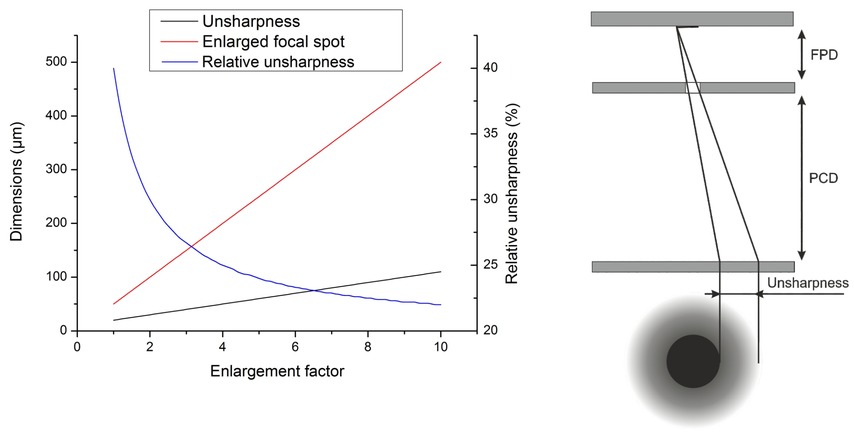
Transverse phase space plots, current density distribution along vertical axis and beam profile on anode

Unit parameters

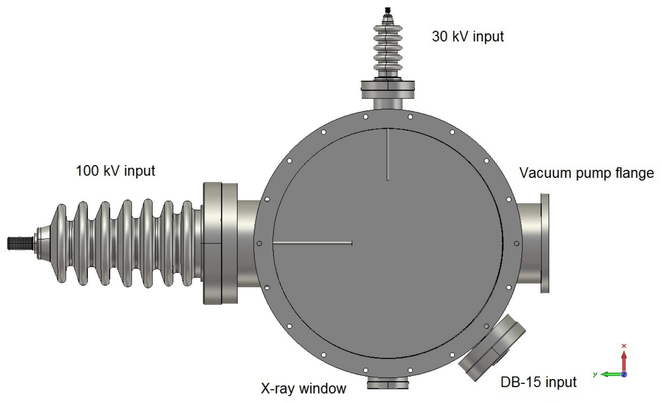
Emitted current	2 A/cm^2
Extracting field	8 V/μm (20 kV)
Cathode sizes	20 mm x 100 μm
Fowler-Nordheim parameters	a=6.3e-6 b=7.3e7
Focusing coefficient	~1:2
Final electrons energy	100 keV
Electrons initial energy	0.2 eV ± 100%
Electrons initial angle	±45^o

X-ray measurement

Method	CCD with pinhole
Pinhole aperture	10 μm
Anode broad side tilt	<10^o
Electron pulse length	5 ms
Surface heating temperature	<2000 K
Focal spot enlargement factor	>3

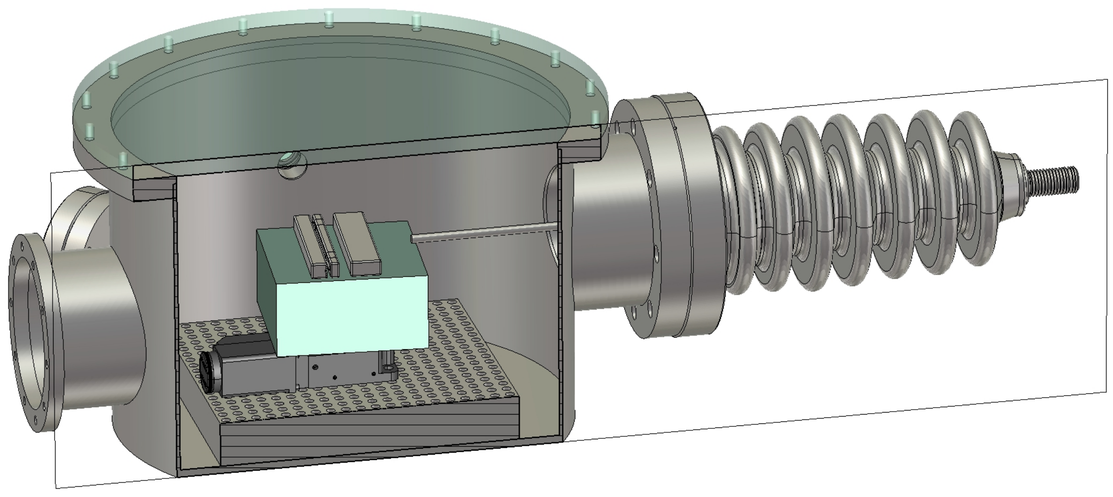


X-ray focal spot and unsharpness



Vacuum system, voltage control

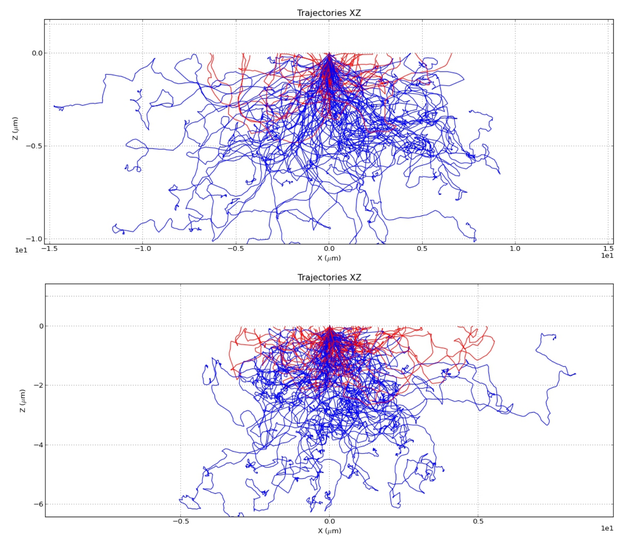
High-voltage feedthroughs	30, 100 kV flanges
Extracting pulse length	20 ns - inifinity
Maximum beam power	6 kW
Goniometer control feedthrough	DB-15 flange
Vacuum pumps	Spiral pump, turbo molecular pump
Vacuum level	10^{-4} Pa



Vacuum chamber scheme with experimental setup alignment

Anode characteristics

Material	Tungsten/Molybdenum
Electron penetration depth	5.2/9.7 μm
Electron penetration width	4.0/7.5 μm
Electron pulse length	5 ms
Surface heating temperature	<2000 K



Electrons trajectories in the anode:
Molybdelum (top) / Tungsten (bottom)