ISIS@MACH ITALIA

Science and Technology Facilities Council
ISIS Neutron and Muon Source

Experiment Proposal

Experiment number GP2022013

Principal investigator	Professor Alessandro Cianchi, University of Rome Tor Vergata, ITALY
Co-investigator	Professor Carla Andreani, University of Rome Tor Vergata, ITALY
Co-investigator (*)	Professor Enrica Chiadroni, Sapienza University of Rome, ITALY
Co-investigator	Dr Luigi Faillace, INFN-LNF Frascati, Rome, ITALY
Co-investigator	Dr Mario Galletti, Universitá di Roma Tor Vergata, ITALY
Co-investigator	Dr Andrea Liedl, INFN, ITALY
Co-investigator	Dr Riccardo Pompili, INFN, ITALY
Co-investigator	Dr Giovanni Romanelli, University of Rome Tor Vergata, ITALY
Co-investigator	
Experiment title	Elemental and surface characterization of cathodes for photoinjectors
SRF Instrument	**Scanning Probe Microscopes**
Access Route	Rapid Access
Science Areas	Materials, Physics, Technique Development
Sponsored Grant	None
Grant Title	-
Start Date	-
Similar Submission?	-
Industrial Links	-

Days requested: 2
Previous GP Number: -
DOI: -
Sponsor: -
Grant Number: -
Finish Date: -

Non-Technical Abstract

High brightness machines, like Free Electron lasers, are driven by photoinjectors. The quality of the electron beam extracted from the source is paramount for the whole machine's performance.

Copper cathodes are widely used, as electron sources, for their reasonable quantum efficiency, robustness, simple treatment, and implementation. However, copper cathodes, exposed to strong electric fields and continuously bombarded with high-intensity lasers, can degrade their quantum efficiency for several reasons. The most common problem is surface contamination, mainly due to carbon ions, but also thermal stress can induce dislocations inside the material that leads to extrusion, creating a tip where the electric field can grow up, leading to a dangerous discharge.

The change in quantum efficiency or, even worse, the difference in this parameter point by point can dramatically affect the beam properties, degrading the emittance and producing poor radiation source performances.

To this end, we propose performing an experiment to precisely analyze the material surface and bulk properties to understand all these features better, comparing cathodes before and after their usage inside an RF gun.

The investigation will include a technique to monitor the surface morphology, using SEM like the Tescan Vega SEM-EDX (Scanning Probe Microscope) SRF of ISIS@MACH ITALIA, to see the signature of potential damages induced by arc discharges, and with EDS to show possible surface contaminants. Also, all the instrumentation to monitor the bulk properties and lattice stress should be applied, relying on X-rays or neutrons.

Publications -

Instruments	
Access Route	
Science Areas	
Sponsored Grant	
Grant Title	
Start Date	
Similar Submission?	
Industrial Links	

Days Requested:
Previous RB Number:
DOI:
Sponsor:
Grant Number:
Finish Date:

Sample record sheet

Principal contact Professor Enrica Chiadroni, Sapienza University of Rome, ITALY
SRF Instrument **Scanning Probe Microscopes** **Days Requested:** 2
Special requirements:

SAMPLE

Material	Cu Oxygen free 99.95% exposed to RF	Cu Oxygen free 99.95% not exposed to RF	-
Formula	Cu	Cu	-
Forms	Solid	Solid	
Volume	60 cc	60 cc	
Weight	0.5 Kg	0.5 mg	
Container or substrate	-	-	-
Storage Requirements	Inert gas	Inert gas	-

SAMPLE ENVIROMENT

Temperature Range	- K	- K	-
Pressure Range	- mbar	- mbar	-
Magnetic field range	- T	- T	-
Standard equipment	None	None	-
Special equipment	Sample to store in inert gas	-	-

SAFETY

Prep lab needed	Yes	Yes	-
Sample Prep Hazards	-	-	-
Special equip. reqs	-	-	-
Sensitivity to air	Yes	Yes	-
Sensitivity to vapour	Yes	Yes	-
Experiment Hazards	-	-	-
Equipment Hazards	-	-	-
Biological hazards	-	-	-
Radioactive Hazards	-	-	-
Additional Hazards	-	-	-
Additional Details	-	-	-
Sample will be	Removed By User	Removed By User	-