BREAKDOWN STUDY ON AN X-BAND RF GUN

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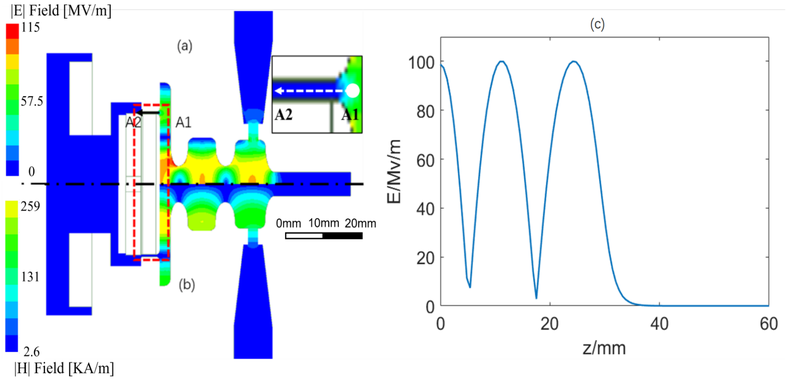
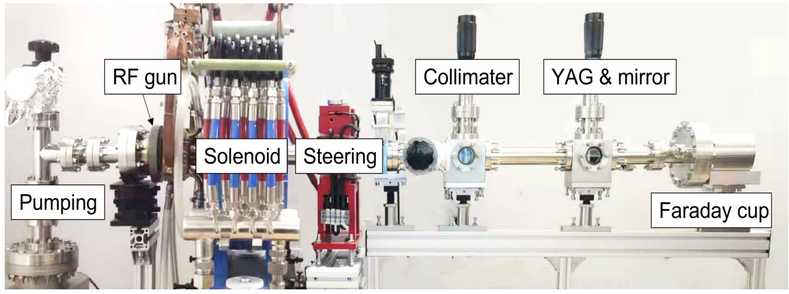
Introduction

To investigate the mechanism of RF breakdown, we have developed an X-band field emission RF gun and conditioned cathodes with different surface states. A dark current image beamline was built with this gun to observe the evolution of filed emitters during high power RF conditioning.

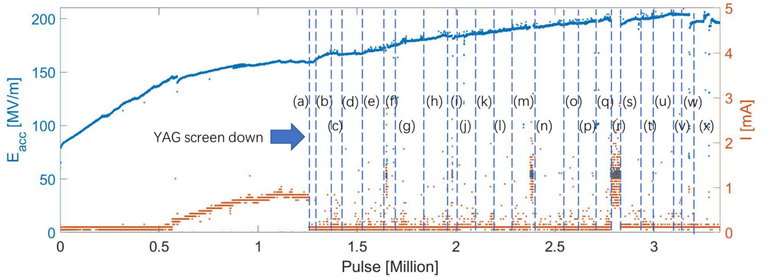


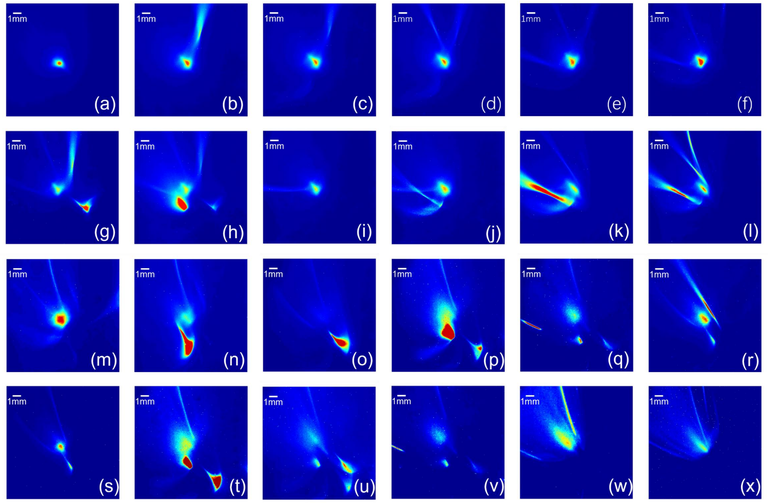
Field distribution of the X-band RF gun



Setup of the beamline

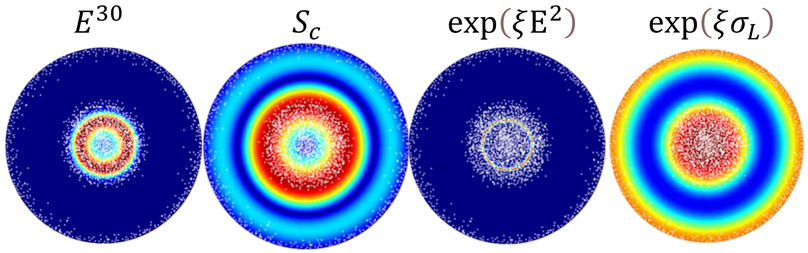
Evolution Of Field Emitters



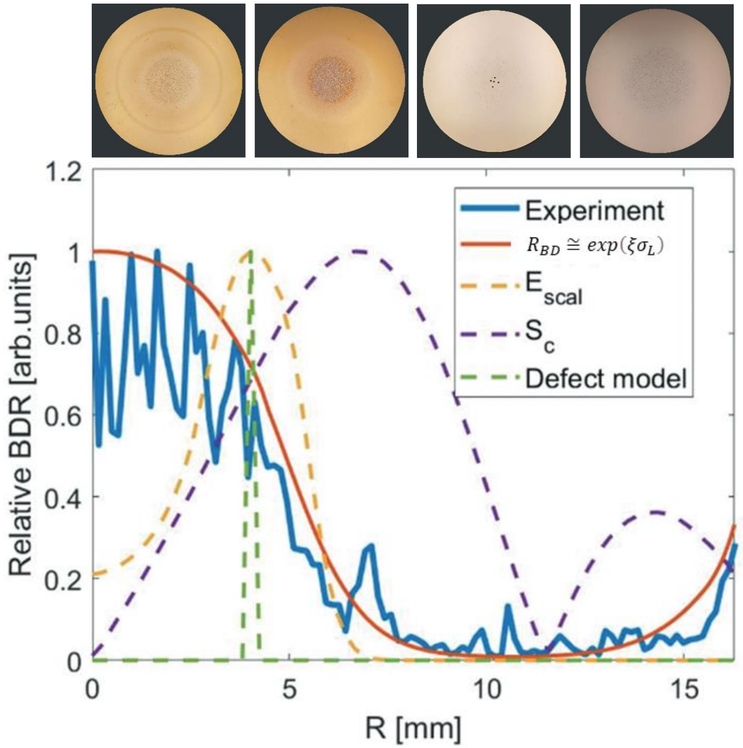


Immediately after a breakdown event, strong field emitter spontaneously burst on the YAG screen and gradually disappeared as the RF pulse accumulates. These field emitters may be the residue of surface micro tips formed from subsurface defects inside the metal shallow layer by the action of the RF electric field.

Distribution of Breakdown Sites

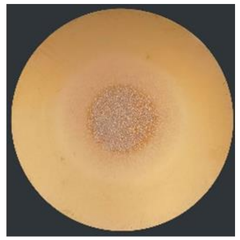


The distribution of breakdown sites is consistent with the distribution of Lorentz force on the cathode surface.



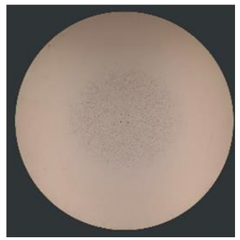
Conditioning of cathodes

Ca.1 soft copper

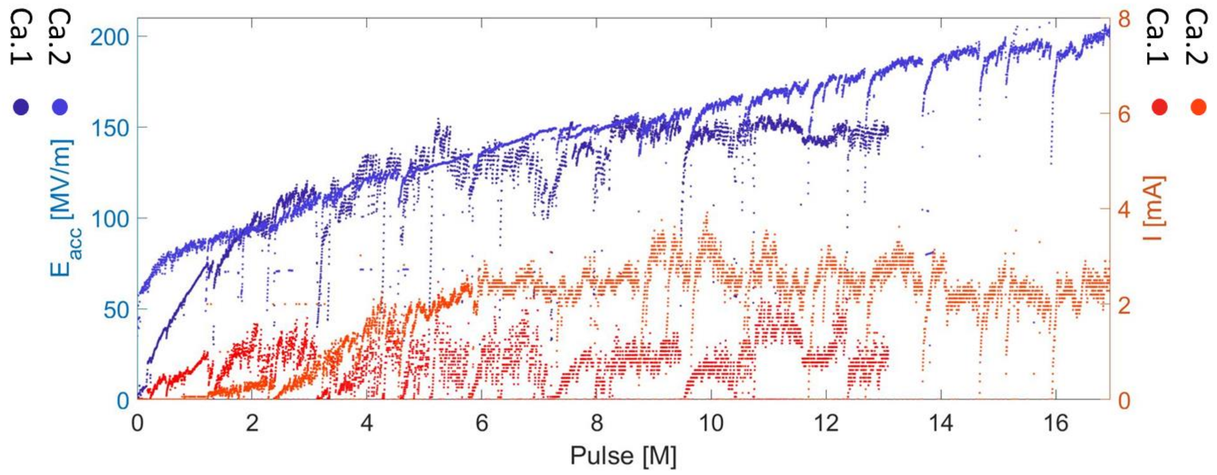


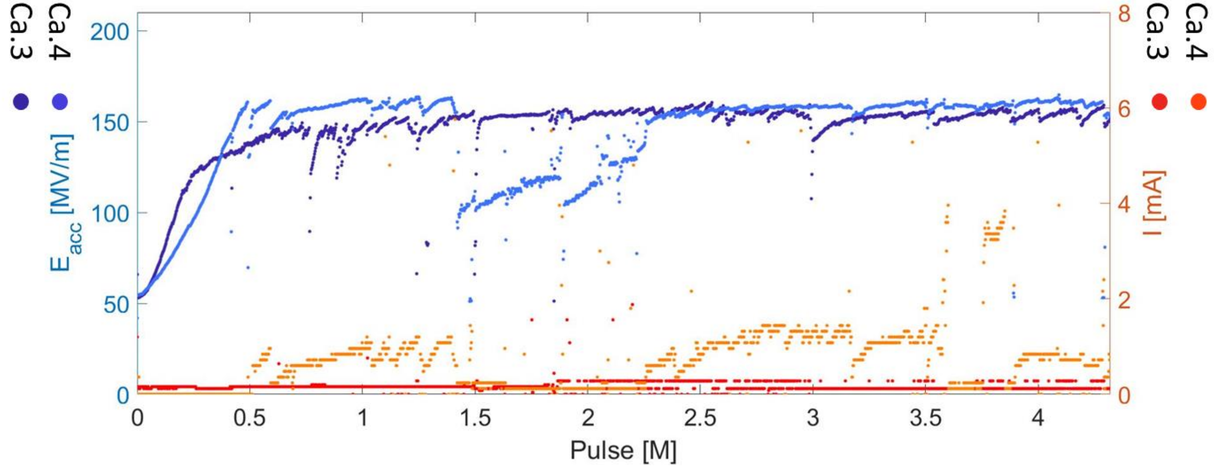
Ca.2 hard copper

Ca.3 mirror surface

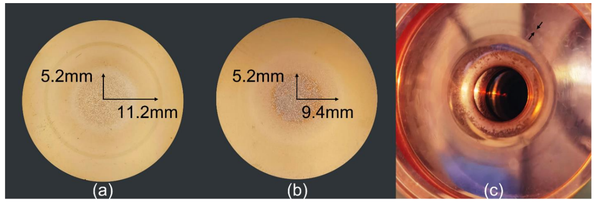


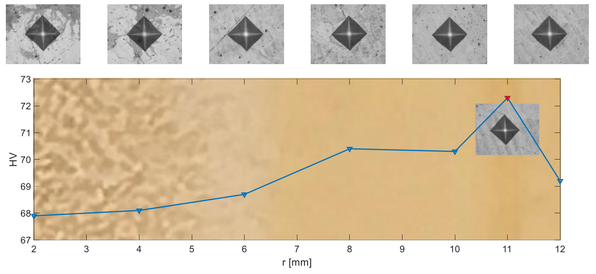
Ca.4 with surface holes

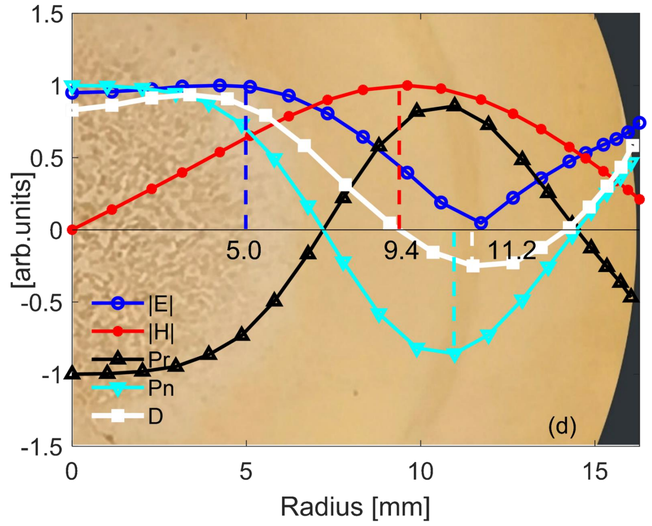




PLASTIC DEFORMATION







After conditioning, Plastic deformation rings and local hardening were found on the surfaces of cathode NO.1, 2. The light ring was caused by thermal stress while the dark ring was caused by Lorentz force.

CLUSTERING OF BREAKDOWN SITES