

Cockcroft Institute Seminar

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Walton Rooms A & B, The Cockcroft Institute**

**Title: Multiphysics simulations of onset of vacuum electrical breakdowns:
High electric field effects on conducting surfaces**

Abstract

Breakdown events frequently taking place near conducting surfaces exposed to high electric fields cause modification of the surfaces of accelerating structures and unwanted power consumption -- a nuisance limiting the value of applied fields. An atom-level theoretical model of surface behaviour under high electric fields, which we are currently developing, suggests the possibility of surface hardening under applied fields. The dislocation-based mechanism may explain the formation of a surface protrusion, acting on the later stage as a full size field emitter, which may develop at the certain circumstances in a breakdown spot. Hence our model aims to explain the physical limitation of a metal surface due to electrical breakdowns at the fields that are still well below the critical values known to cause field-assisted evaporation of atoms. We model all three main stages of plasma development ignited in ultra-high vacuum, i.e. plasma onset, plasma evolution and surface damage due to the plasma discharge.

The main emphasis of the presentation will be on the triggering process of plasma ignition event due to the high electric field, as well as the discussion on the plasma-ion "shower" during the vacuum arcing and the resulting surface response. A possible mechanism for formation of a surface protrusion mediated by dislocations nucleated on a near surface void under high electric field will be discussed in detail. A modified molecular dynamics code, which includes the effects of electric fields such as partial charge on surface atoms as well as the Joule heating of surface asperities due to electron currents will also be presented. This information is plugged in to the simulation of plasma development, whose output is used to simulate the surface damage. The simulated surface damage is well compared with the craters formed by the plasma discharge in DC-spark setup (CERN).

Refreshments will be available