# Comments on Breakdown

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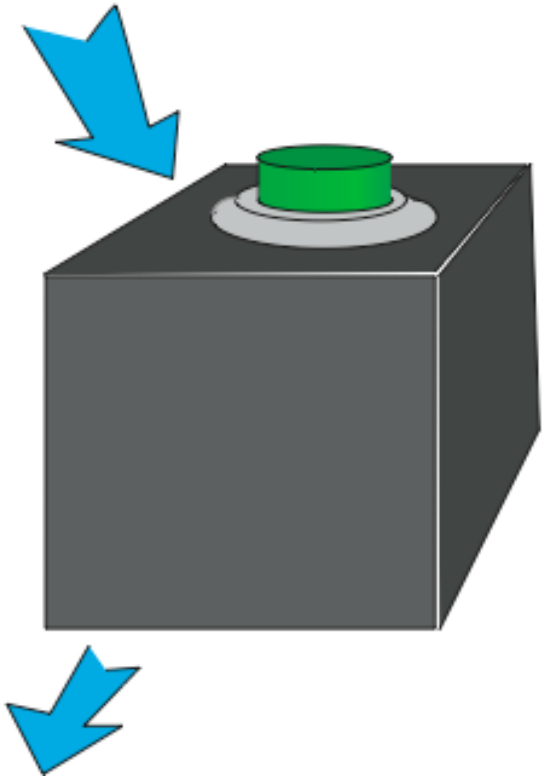
# We try to keep things simple.

Minimal assumptions

$E_{surf}$, Surface Parameters, Plasma model, Molecular Dynamics



Something straightforward

Maximum Output

Breakdown rate, Pulse length, Electric field, Materials dependence, Conditioning procedures, The fully conditioned state, Gas type, Gas pressure, Magnetic fields, Frequency dependence, DC gaps, Temperature dependence, Correlated breakdown

events, Timescale of breakdown process, Plasma spots, Crater clustering, PS and geometry dependence of gradient limits, Surface heating, Fatigue, Disappearance of field emitters during breakdown, Simple failure of atom probe tomography systems, Surface morphology, Superconducting systems, Positive and negative potentials, enhancement spectra, breakdown thresholds, time development of arc, termination of discharge, Arc loading, Optical spectra, Ionization mechanisms, Mitigation of Breakdown , Mitigation of field emission

etc.

# There are many possible Trigger Mechanisms (Combinations count)

Dyke and Trolan - Ohmic heating
  Worked out in 1953 by very careful guys, applies to needles.

Oxide heating
  Hard to parameterize

Oxide differential expansion + fracture
  It has to be there at some level

Shock heating
  Requires external source

Solute Segregation
  Slowly degrades grain and oxide boundaries

Defect migration / creep
  Good stuff

Surface atom migration

Not seen in Atom Probe

Outgassing + avalanche

Oxides tend to be tightly bound, outgassing is not seen

Fracture

Simple

Fatigue

Not really a microscale phenomenon

External (x rays)

Requires external source

Sequential plastic deformation

Not seen in Atom Probe

External (gas)

Can exist in some exotic circumstances

Pilot ray

Field emission beams have very little energy

Plasma spot

What are these? Bonin says hot dielectrics.

Perry Wilson model

People like it, but not constant or well defined

# We are beginning to get results from the software.

Axial magnetic fields of 1 T produce ~10 times more line radiation after 5 ns.

Implies ~3 times higher local density.

Predicts:

- More heat to the wall
- Faster development of spark
- More surface damage.
- Lower $E_{acc}$