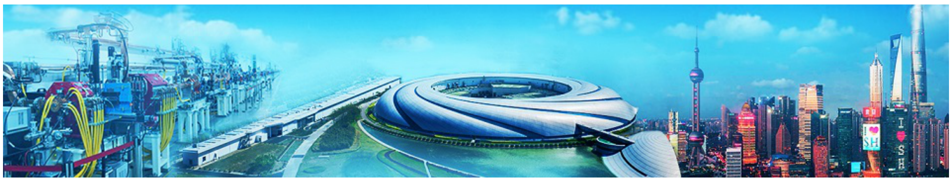

Contribution ID: **24** Type: **not specified**

Linking breakdown nucleation to critical plastic activity in electrode

Thursday 7 June 2018 09:00 (25 minutes)

It has long been assumed that breakdown (BD) in vacuum cavities is initiated by field emission from localized surface irregularities causing localized field enhancement. However, the nature of these localized field enhancement region is unknown as of today, and remains as a missing part on the microscopic description of the BD process. This limits the ability to predict breakdown properties of materials as well as engineer materials which can withstand higher gradient as well as create improved conditioning methods.
The presentation covers recent experimental and theoretical efforts to establish the possibility that breakdown nucleation happens through a critical transition in the dislocation population driven by stresses as a result of the applied field. A stochastic mean field model was developed based on dislocation multiplication due to stresses generated below the exposed surface. Field and temperature dependencies of breakdown rates measured in SLAC and CERN using accelerating structures were used to calibrate and then validate the model. Microscopy work, including SEM and TEM on post mortem samples taken from accelerating structures demonstrate that while breakdown is a violent event involving melting and splashing of the electrode surface, we can identify pre-breakdown sub surface evolution which we propose is related to the described mechanism and may lead to subsequent conditioning. Finally, I will discuss prospects for advancement in mechanism identification using dedicated experiments, some of which are currently underway.

[1] E.Z. Engelberg, Y. Ashkenazy, M. Assaf, Phys. Rev. Lett. 120 (2018) 124801, https://link.aps.org/doi/10.1103/PhysRevLett.120.124801

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Session Classification: Breakdown and Experiments