Contribution ID: **88** Type: **Oral**

Suggestions about the role of carbon nanowhiskers in electrical breakdown

Monday, 16 September 2019 09:10 (20 minutes)

This paper brings together various pieces of theoretical argument and experimental evidence to support the idea that, in some cases, electrical breakdown may be associated with the growth of carbon nanowhiskers. An introduction provides two reminders. (a) That effects of this kind are driven by electrical thermodynamics and by the rule that systems evolve in a direction such that the electrical Gibbs function becomes more negative—possibly/probably with both an electrical surface term and a field-energy (or "capacitance") term contributing, at least in some circumstances. And (b) that (for so-called "ideal" field electron emitters) it is possible to use a Fowler-Nordheim plot (or a Murphy-Good plot) to measure––with an accuracy estimated as 30%––a characteristic value of local electric field or (better) a characteristic value f_C of scaled field f . Possible mechanisms for the formation and growth of carbon nanowhiskers will be discussed. In this, an important role is played by the results in papers written by a group of French authors, but there is much other evidence. Also of interest is the long established work on so-called "low-macroscopic-field (LMF) electron emission" from carbon, particularly in the Russian literature. Up till now there has been some tendency to look for "special explanations", such as resonance tunnelling. However, FN-plot techniques have recently been used to measure the local fields involved, and these have been found to have normal values (of a few V/nm). This suggests that a highly plausible alternative explanation of LMF emission is that carbon-based emitters are capable of exhibiting unexpectedly high (one might say "anomalously high") field enhancement factors.

Primary author: Dr FORBES, Richard (University of Surrey)

Presenter: Dr FORBES, Richard (University of Surrey)

Session Classification: Field Emission - Modeling and Simulations

Track Classification: Field Emission