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CHARACTERIZING THE INFLUENCE OF ELECTRODE SURFACE MORPHOLOGY ON FIELD EMISSION

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Field emission (FE) from high-voltage electrode surfaces governs arc breakdown processes in the limit of microscale electrode spacings. In this regime, microscopic features of the electrode surface exert an influence on emitted electrons via local field enhancement at high-aspect-ratio features and work function variation. However, the tendency for surface charge distributions to alter the apparent work function locally (e.g., from stepped surfaces, physi-/chemisorbed layers) has been less a feature of breakdown models that incorporate FE processes. To improve these models, morphology and local work function of polycrystalline Pt (poly-Pt) thin films were characterized using an array of techniques, including transmission electron microscopy (TEM), electron backscatter diffractometry (EBSD), atomic force microscopy (AFM), and photoemission electron microscopy (PEEM). Where work function values of clean, single-crystal Pt(111) approach 6 eV, grain tilt and surface morphology measurements suggested a lowering of the poly-Pt work function by 0.42 +/- 0.20 eV. This was confirmed by local work function maps acquired with PEEM, which showed an average work function of 5.60 eV, with a standard deviation of 30 meV. Measured work function distributions and surface morphology were incorporated into discharge simulations to model field emission based on local surface properties.

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