Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Nano-crater Formation on Electrodes during the Electrical Charging of Aqueous Droplets ERIC ELTON, ETHAN ROSENBERG, WILLIAM RISTENPART, Dept. Chemical Engineering, University of California Davis — A water drop in an insulating fluid acquires charge when it contacts an electrode, but the exact mechanism of charge transfer has remained obscure. Previous work, dating back to Maxwell, has implicitly assumed that the electrode remains unaltered by the charging process. Here we demonstrate that, contrary to this assumption, water drops and other conducting objects create "nano-craters" on the electrode surface during the charging process. We used optical microscopy, SEM, and atomic force microscopy to characterize the electrode surfaces before and after water drops were electrically bounced on them. We show that each drop contact creates an approximately micron wide and 30-nm deep crater to form on the electrode surface. Given enough time, the drop will form enough nano-craters to effectively 'eat through' a sufficiently thin electrode. We discuss possible physical mechanisms for the nano-crater formation, including localized melting caused by Joule heating during the charge transfer event. The observations reported here are of particular interest in the development of microfluidic devices that use thin film electrodes to control the motion of aqueous drops.

William Ristenpart
Dept. Chemical Engineering, University of California Davis

Date submitted: 01 Aug 2015 Electronic form version 1.4