Scaling Behavior of Dielectric Switching in Nano-assemblies\textsuperscript{1}

FENG CHEN, JASON SHULMAN, STEPHEN TSUI, YUYI XUE, C. W. CHU\textsuperscript{2},
Texas Center for Superconductivity, University of Houston, Houston, TX 77204-5002 — Recently, we have reported a field-induced sign-switch of dielectric constant ($\varepsilon'$) for urea-coated Ba$_{0.8}$Rb$_{0.4}$TiO$_2$(C$_2$O$_4$)$_2$ nano-particles (U-BRTOCO) in silicone oil and demonstrated that the observed negative $\varepsilon'$ is an intrinsic property of the nano-particle assemblies. A systematic study has been subsequently carried out on the switching of $\varepsilon'$ under a bias field for U-BRTOCO and other nano-particle assemblies under different conditions. The switching frequency ($\omega_c$) is found to be closely related to the zero-frequency electrical conductivity ($\sigma(0)$) of the assemblies. Such a scaling behavior for different nano-assemblies under various conditions gives us strong insight of the origin of the negative $\varepsilon'$. The possible models such as plasma and 2D electron-gas (2DEG) are compared.

\textsuperscript{1}We thank Prof. W. J. Wen for supplying U-BRTOCO samples.
\textsuperscript{2}Also at: Lawrence Berkeley National Laboratory, Hong Kong University of Science and Technology

Date submitted: 30 Nov 2005

Electronic form version 1.4