Narrative Highlight Text: This work demonstrates a way of controlling friction on ionic surfaces at the nanoscale by using electrical stimulation and ambient water vapor. Frictional forces arise whenever objects around us are set in motion. Controlling them in a rational manner means gaining leverage over mechanical energy losses and wear. This paper presents a way of manipulating nanoscale friction by means of in situ lubrication and interfacial electrochemistry. Water lubricant is directionally condensed from the vapor phase at a moving metal-ionic crystal interface by a strong confined electric field, thereby allowing friction to be tuned up or down via an applied bias. The electric potential polarity and ionic solid solubility are shown to strongly influence friction between the atomic force microscope (AFM) tip and salt surface. An increase in friction is associated with the AFM tip digging into the surface, whereas reducing friction does not influence its topography. No current flows during friction variation, which excludes Joule heating and associated electrical energy losses. The demonstrated novel effect can be of significant technological importance for controlling friction in nano- and micro-electromechanical systems.

Reference
“Nanoscale Lubrication of Ionic Surfaces Controlled via Strong Electric Field”
Evgheni Strelcov,1 Rajeev Kumar,1,2 Vera Bocharova,3 Bobby G. Sumpter,1,2 Alexander Tselev,1 and Sergei V. Kalinin1
1Center for Nanophase Materials Sciences, Oak Ridge National Laboratory, Oak Ridge, TN 37831; 2Computer Science and Mathematics Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831; 3Chemical Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831
Scientific Reports 5, 8049 (2015). DOI: 10.1038/srep08049

Acknowledgement of Support
This research was conducted at the Center for Nanophase Materials Sciences, which is sponsored at Oak Ridge National Laboratory by the Scientific User Facilities Division, Office of Basic Energy Sciences, U.S. Department of Energy. VB would like to acknowledge sponsorship by the Laboratory...
Directed Research and Development Program of Oak Ridge National Laboratory, managed by UT-Battelle, LLC, for the U. S. Department of Energy. ES and SVK would like to thank Dr. P. Collier for fruitful discussion. ES gratefully acknowledges Mr. A. Strelkov for his help in illustrating this manuscript.