Electrostatically and Electrochemically Induced Superconducting State Realized in Electrochemical Cells

Y. Kasahara[a], T. Nishijima[b], T. Sato[b], Y. Takeuchi[a], H. T. Yuan[a], J. T. Ye[a], H. Shimotani[a], and Y. Iwasa[a]

[a]Quantum-Phase Electronics Center and Department of Applied Physics, School of Engineering, The University of Tokyo, Japan
[b]Institute for Materials Research, Tohoku University

We here report AC magnetization measurements of electrochemical cells, in which two electrodes are immersed into an electrolyte, at low temperatures with applying voltages between the electrodes. Utilizing electrochemical cells, we can tune charge density in the materials through electrochemical reaction in the bulk or electrostatic charge accumulation on the surface due to strong electric field caused by a formation of electric-double-layers at the electrolyte/electrode interfaces.
When layered band insulators ZrNCl and HfNCl were employed in the electrochemical cells with ionic liquid as a gate dielectric and a Pt counter electrode, two-dimensional superconducting state on the surface of materials and a switching from an insulator to a superconductor by the voltage were clearly demonstrated,[1] suggesting that our technique may become a novel tool for exploring electric-field-induced superconductivity. We also show the results of electrochemical syntheses on materials including aromatic hydrocarbons.

[1]Y. Kasahara *et al.*, J. Phys. Soc. Jpn **80**, 023708 (2011).