Electric Field Induced Phase Changes in Transition Metal Oxides

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【Outline of survey】

A rich variety of electronic phases in transition metal oxides, including magnetic/nonmagnetic insulator, magnetic/nonmagnetic metal, superconductor, are often competing with each other on a delicate balance and gives rise to a phase change upon application of electric and magnetic fields. Devices, using a gigantic response associated with such phase changes, are now anticipated as key elements for next generation electronics. Linked to the progress in transition metal oxide physics, device functions induced by magnetic field have been studied widely. More recently, significant progress was achieved in electric field induced phase change devices which are easier to operate. In spite of drastic technical advances, however, the operation mechanism and the microscopic electronic state are yet to be clarified. Understanding the interfacial electronic states and the mechanism of resistance change, in fact, is an attractive challenge of condensed matter physics. Injection of charge carriers at the interface using electric field can potentially give rise a new paradigm of condensed matter physics, such as electric field induced superconductivity and magnetism. Recognizing these, this project aims to explore the interfacial electronic states of oxide transistor, to search for electric field induced exotic phases and to understand the mechanism of oxide resistance switching memory in the given five years.

【Expected results】

By clarifying the interfacial state of oxide transistor and the mechanism of resistance switching, substantial contributions to promote the future oxide electronics are expected. Since resistance switching memory is generally regarded as a potential candidate for next generation memory, the understanding of the switching mechanism has been highly desired from industries. Realization of exotic electronic phases by electrostatic carrier doping using oxide field effect transistor (FET)r, in particular gate-induced superconductivity, is expected.

【References by the principal investigator】

- *"Low temperature metallic state induced by electrostatic carrier doping of SrTiO3"*, H. Nakamura, H. Takagi, IH. Inoue *et al.*, Applied Physics Letters **89**,133504 (2006)
- *"Field-effect transistor based on $KTaO_3$ perovskite"*, K .Ueno, I. H.Inoue, H. Takagi *et al.*, Applied Physics Letters **84**, 3726-3728, (2004).

【Term of project】 FY2007－2011	【Budget allocation】 31,600,000 yen (2007 direct cost)

【Homepage address】

http://www.appchem.t.u-tokyo.ac.jp/appchem/labs/takagi/index-j.html