# The study of novel quantum phenomena caused from the competition among multiple ground states in vanadium oxides

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**【Outline of survey】**

Since vanadium oxides can take various valence states ($V^{2+}$～$V^{5+}$) of vanadium ion, various coordinations and oxygen nonstoichiometry, they are very rich in the structure and the number of compound. Such vanadium oxides are the playground of strongly correlated d-electrons in which rich varieties of electromagnetic and optical properties caused by the coupling among the charge, orbital spin and lattice degrees of freedom emerge. The aim of this study is to synthesize vanadium and its related oxides by using various methods in solid state chemistry and to thoroughly investigate their structural and physical properties, for examples, metal-insulator transition, charge order transition accompanied by the formation of spin gap, charge order and pressure-induced superconductivity, orbital order driven (spin-) Peierls transition, various quantum spin phenomena and so on, in a wide region of temperature and pressure. The goal of this study is to elucidate the competition among multiple ground states underlying these novel quantum phenomena characteristic of vanadium oxides.

**【Expected results】**

In this research project, various novel phenomena characteristic of vanadium oxides can be elucidated. Eventually, the comprehension of $t_{2g}$-electron correlation effect can be deepened and various problems on the strongly correlated d-electron systems are expected to be solved. The study of strongly correlated electrons has been a central issue in solid state physics and chemistry fields in terms of not only fundamental science but also a potential of applications. The development of new materials and new properties are expected to lead to new frontiers in solid state physics and chemistry.

**【References by the principal researcher】**

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| 【Term of project】 FY2006－2010 | 【Budget allocation】29,300,000 yen |
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【Homepage address】 http://yueda.issp.u-tokyo.ac.jp/