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Design of electronic transport property through electronic phase manipulation in correlated electron materials

Teruo Kanki
Osaka University, Japan

Abstract

Strongly correlated electron systems are of much interest for the development of highly sensitive sensors and memories that utilize the Mott transition. Especially high temperaturephase change materials arepromising to lead to realization of their practical devices. When focusing on the nano-spatial area in these materials, metallic and insulating states are randomly mixed, forming domains with several hundreds of nanometer in scale near metal-insulator transition (MIT).Each domain plays an essential role indetermination of observed electronic transport properties. The key point for effective control and artificial designing of the transport property is to arrange random domain configuration and to manipulate MIT in each domain.In this presentation, I will demonstrate the manipulation of transport propertiesby artificial control of the spatial domain configurationthrough control of the size andaspect ratio of VO_2 thin filmswhich is a typical phase change material.A random configuration of two dimensional (2D) metallic domains was observed intypical films with several hundreds of micrometers in scale, showing moderate MIT at 300K, following the 2D percolation model. In the case of the 1D domain configuration in micro-scaled films, on the other hand, the apparent transition temperature drastically shifts from approximately 294K in the 1D parallel domain configuration to 312 K in the 1D series one. Notably, a very steep and abrupt resistive drop occurs in the parallel configuration. Thus I experimentallymade it clear that the domain configurations have a crucial impact on the determination of the electrical transport properties.

Biography

Teruo Kanki has completed his Ph.D. in material physics from Osaka Universityin 2004. After a visiting researcher in IBM's Almaden Research Center from 2004 to 2006, he became a specially appointed assistant professor in Osaka University. Now he is an associate professor in Osaka University and works on novel and new concept oxide nano-electronics. He has published more than 50 papers in reputed journals.