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

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Strongly correlated electron systems are of much interest for the development of highly sensitive sensors and memories that utilize the Mott transition. Especially high temperature phase change materials are promising 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 in determination 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 properties by artificial control of the spatial domain configuration through control of the size and aspect ratio of VO_2 thin films which 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 300 K, 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 294 K 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 experimentally made 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 University in 2004. After serving as 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.

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