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Memristive metal-insulator switches in correlated electron oxide nanowires using electric field-induced redox reaction

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Electric field-induced metal-insulator transition in correlated electron materials has been attracting much attention as not only a mainstream in a development of oxide electronics but also a platform for investigation of condensed-matter physics. In the common motivation, electric field at gate has been used as accumulation and depletion of electric charge carriers to cause drastic change of the transport property because the correlated electronic phases are very sensitive to the number of carriers. However, it is beginning to be understood that the strong electric field induces redox reaction of into or out of oxygen or hydrogen at the interface in oxide channels, especially in applying ion liquid gates. Recently, as a new concept device actively for focusing on the field induced-redox reaction in oxides using water, large modulations of transport and thermopower properties were reported. Water would be a key material to cause strong redox reaction in oxides by an electric field because electrolyzed water separates the strong active agents of H+ and OH- /O2- ions. In this research, we demonstrate reversible and memristive modulation of transport properties in vanadium dioxide (VO2) nanowires, which is a prototypical correlated electron material, using electric field-induced water electrolysis through air nano-gap in a planer type gate. The device totally works under an ambient air condition at room temperature. Our results offer a newly convenient technique to induce redox reaction and will serve as a powerful tool for examining transport properties on redox effect.

Biography

Teruo Kanki has completed his PhD in material physics from Osaka University in 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 60 papers in reputed journals.

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