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Atomic Level Design Rule for Ta-based Resistive Switching devices SEO HYOUNG CHANG, Materials Science Division (MSD), Argonne National Laboratory (ANL), S. HONG, Center for Nanoscale Materials, ANL, M.-J. LEE, Y.-B. KIM, Semiconductor Device Laboratory, Samsung Advanced Institute of Technology, S. CHATTOPADHYAY, T. SHIBATA, CSRRI-IIT, Physics Dept., Illinois Institute of Technology (IIT) and MRCAT, Advanced Photon Source (APS), B. MAGYARI-KOPE, Dept. of Electrical Engineering, Stanford University, J.A. KADUK, Chemistry dept., IIT, J.A. EASTMAN, MSD, ANL, J. KIM, APS, ANL — Understanding resistive switching phenomena is a prerequisite to realizing the next generation of information storage systems. Ta-based resistive switching devices have been extensively investigated due to their fast switching and reliable endurance among other materials. Despite extensive recent interests, there is still a lack of fundamental understanding of electronic structure and local structure of the Ta-based device. Here, we investigated Ta_2O_5 powder, $Ta_2O_{5-\delta}$ and TaO_x thin films and devices using synchrotron x-ray studies at the Advanced Photon Source, combining resonant x-ray inelastic scattering (RIXS), extended x-ray absorption spectroscopy (EXAFS) and density functional theory based *ab initio* calculations. We found that there are strong correlations between critical values of band gap energies and local atomic environments around Ta atoms. These studies can provide vast possibilities to create new materials based on atomic level design rather than the traditional trial-error methods. Work at the APS, Argonne is supported by a U.S. Department of Energy Office of Science laboratory, is operated under Contract No. DE-AC02-06CH11357.

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