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Unipolar Field-Effect Diode Based on a Complex Oxide[1] WENG LEE LIM, SERGEI URAZHDIN, Department of Physics, Emory University, Atlanta, EUN JU MOON, MICHAEL KAREEV, DEREK MEYERS, JAK CHAKHALIAN, Department of Physics, University of Arkansas, Fayetteville, JOHN FREELAND, Argonne National Laboratory, Argonne — We demonstrate rectifying behavior in a field-effect device structure fabricated from thin $NdNiO_3$ films grown on $SrTiO_3$ substrates by the pulsed laser deposition technique. In contrast to the conventional three-terminal field effect devices, the device has only two terminals with the field gate electrode connected to one of the terminal electrodes. The active device area is a $10\mu m \times 10\mu m$ square with a $Au/Al_2O_3/NdNiO_3/SrTiO_3$ structure, where Au and Al_2O_3 are the gate and the gate insulator, respectively. At small bias voltages, the device exhibits a metal-insulator transition near T=150K, similar to extended $NdNiO_3$ films. I-V measurements reveal a strong dependence of device characteristics on temperature, applied bias, and both thermal and applied bias histories. We analyze the IV characteristics by using a modified charge-control model based on accumulation of charges in the channel near the gate oxide interface. We deduce the temperature dependence of the effective zero-field charge carrier mobility for the channel by including a field-dependence mobility. The observed hysteretic effects can be utilized in complex oxide devices that combine together both the diode and the memory functionalities.

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