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Effect of charge on the ferroelectric field effect in strongly correlated oxides XUEGANG CHEN, ZHIYONG XIAO, XIAOZHE ZHANG, LE ZHANG, WEIWEI ZHAO, Department of Physics Astronomy, University of Nebraska-Lincoln, NE 68588, XIAOSHAN XU, XIA HONG, Department of Physics Astronomy and Nebraska Center for Materials and Nanoscience, University of Nebraska-Lincoln, NE 68588 — We present a systematic study of the effect of charge on the ferroelectric field effect modulation of various strongly correlated oxide materials. We have fabricated high quality epitaxial heterostructures composed of a ferroelectric $Pb(Zr,Ti)O_3$ (PZT) gate and a correlated oxide channel, including $Sm_{0.5}Nd_{0.5}NiO_3$ (SNNO), $La_{0.7}Sr_{0.3}MnO_3$ (LSMO), SNNO/LSMO bilayers, and $NiCo_2O_4$ (NCO). The Hall effect measurements reveal a carrier density of ~4 holes/u.c. (0.4 $cm^2V^{-1}s^{-1}$) for SNNO to ~2 holes/u.c. (27 $cm^2V^{-1}s^{-1}$) for NCO. We find the magnitude of the field effect is closely related to both the intrinsic carrier density and carrier mobility of the channel material. For devices employing the SNNO/LSMO bilayer channel, we believe the charge transfer between the two correlated oxides play an important role in the observed resistance modulation. The screening capacitor of the channel materials and the interfacial defect states also have significant impact on the retention characteristics of the field effect. Our study reveals the critical role of charge in determining the interfacial coupling between ferroelectric and magnetic oxides, and has important implications in developing ferroelectric-controlled Mott memory devices.

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