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Manipulation of Carrier Density near Ferroelectric/Semiconductor Interfaces MEHMET KESIM, University of Connecticut, I. BURC MISIRLIOGLU, Sabanci University, JOSEPH MANTESE, United Technologies Research Center, S. PAMIR ALPAY, University of Connecticut — Switchable polarization of a ferroelectric (FE) opens up the opportunity to control the charge density and transport characteristics at the FE/metal and FE/semiconductor (SC) heterointerfaces. Carrier manipulation near such regions can be used in high density non-volatile memories, switchable diodes, and photovoltaic devices. FEs can be utilized as gate oxides in a metal oxide field-effect transistor configuration for non-volatile memory applications with lower gate voltages compared to that of transistors with linear dielectrics. The channel conductance can be modulated reversibly, for instance, by tuning the magnitude and spatial distribution of polarization in the FE. In this study, we show that FE heterostructures can be used to manipulate the conductivity of a FE/SC interface. We employ a non-linear thermodynamic model based on Landau-Ginzburg-Devonshire (LGD) theory to obtain the equilibrium polarization of heterostructures. The carriers along the heterostructures are mapped through coupling the LGD equation with the Maxwell equations and Fermi – Dirac distribution of charged carriers/ionized dopants in the FE and SC. We consider various configurations including FE/SC/paraelectric and FE/SC/FE stacks to investigate the carrier distribution and band bending near such interfaces. The resulting properties are explained through the phase transition characteristics and domain structure of the stacks.

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