Spin-Orbit Interaction and Kondo Scattering at the PrAlO$_3$/SrTiO$_3$ Interface

SHIRIN MOZAFFARI, Department of Physics, The University of Texas at Austin, SAMARESH GUCHHAIT, Microelectronics Research Center, The University of Texas at Austin, JOHN MARKERT, Department of Physics, The University of Texas at Austin — We have investigated the effect of oxygen content, in the $P_{O_2}$ range of $6 \times 10^{-6} - 1 \times 10^{-3}$ torr, on the spin-orbit (SO) interaction at PrAlO$_3$/SrTiO$_3$ interface. The most-conducting 2-D-like PrAlO$_3$ interfaces were not as conducting as comparable LaAlO$_3$ samples, indicating either a steric or mixed-valent effect. The least-conducting, most oxygenated PrAlO$_3$ interface exhibits hole conductivity, a departure from the typical electron-doped behavior. For $10^{-5}$ and $10^{-4}$ torr samples, high-temperature metallic behavior is accompanied by an upturn in resistivity at low temperatures, consistent with Kondo scattering theory; analysis gives a Kondo temperature $\sim 17$ K. The magnetoresistance (MR) for the low $P_{O_2}$-grown samples was modeled with a positive part due to weak anti-localization (WAL) from a strong SO interaction, and a negative part due to the Kondo effect. The variation of MR suggests a strong SO interaction for the $10^{-5}$ torr sample with $H_{SO} = 1.25$ T in both field orientations. The WAL effect is smaller for higher $P_{O_2}$-grown samples, where the high-field MR is dominated by the Kondo effect.