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Valence Fluctuation in Ultrathin$Ti_{1+x}O_2$ on Rutile TiO_2 Q.Y. CHEN[1], P.V. WADEKAR, H.J. HUNAG, S.W. YEH, N.J. HO, National Sun-Yat Sen University, Kaohsiung, Taiwan, H.W. SEO, University of Arkansas, Little Rock, AR, USA, W.K. CHU, Texas Center for Superconductivity, University of Houston, TX, USA — The physical properties of metal oxides (TMO) can change drastically depending on the non-stoichiometry of oxygen, for which rutile TiO_2 single crystals were self-implanted with Ti to acquire a layers of ∼6 nm populated with extra Ti found in +2, +3, and +4 charge states as revealed by X-ray photoelectron spectroscopy (XPS). The formations of the TiO and Ti_2O_3 crystalline phases were verified by high-resolution transmission electron microscopy (HRTEM). Variable-temperature electrical resistivity measurement suggests the occurrence of charge ordering at low temperatures, where weak localization of the charges take hold, commonly observed in heavily doped semiconductors. The magneto-transport behaviors follow mixed scenario of band conduction and fixed range hopping, albeit with different energy scales and weighting factors demarcated by a transition temperature of MR sign change, a signature of valence fluctuation in which the ordered low-temperature phase would melt into the high-temperature disordered phase, or by condensation in reverse. This work was supported by the National Science Council, the Ministry of Education, Taiwan, the National Science Foundation, and the State of Texas through Texas Center for Superconductivity.

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