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Two-dimensional electron gas at surfaces of (001), (110), and (111) oriented $SrTiO_3$ induced by Ar^+-irradiation LUDI MIAO, RENZHONG DU, YUEWEI YIN, QI LI, Penn State University — Two-dimensional electron gases (2DEGs) at transition metal oxide surfaces and interfaces have attracted much attention due to their fascinating exotic properties such as superconductivity, large magneto-resistance (MR), and ferromagnetism. We have created 2DEGs at the surfaces of (001), (110), and (111) oriented $SrTiO_3$ (STO) by Ar^+-irradiation and measured their transport properties. The 2DEGs exhibit a fully metallic behavior with the 2D charge carrier density around 2×10^{14} cm^{-2} and the mobility as large as 5500 $cm^2V^{-1}s^{-1}$ at low temperatures, which is tunable by electric fields applied through STO back gates. We have measured MR anisotropy of the 2DEGs at surfaces of STO with all orientations. We observed combinations of two types of components in their anisotropic MR at low temperatures. While the first type is an STO-orientation-independent two-fold component results from the Lorentz force effect, the second type shows stark differences between these 2DEGs as a consequence of distinct Fermi surface symmetries with different STO orientations. Indeed, it is four-fold for STO (001), two-fold for STO (110) and six-fold for STO (111), respectively.

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