Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Phase diagram and high density two-dimensional electron gas at the $LaAlO_3/La_{0.5}Sr_{0.5}TiO_3/SrTiO_3$ heterostructures HAIJIAO MA, NUSNNI-Nanocore and Physics Department, NUS, ZHEN HUANG, SHENG-WEI ZENG, ANIL ANNADI, NUSNNI-Nanocore, NUS, THIRUMALAI VENKY VENKATESAN, ARIANDO ARIANDO, NUSNNI-Nanocore and Physics Department, NUS, ARIANDO RESEARCH GROUP TEAM[1] — We report a two dimensional electron gas with a high carrier density at the $LaAlO_3/La_{0.5}Sr_{0.5}TiO_3/SrTiO_3$ heterostructures, reaching a value of about five times higher than that observed at the $LaAlO_3/SrTiO_3$ interface. The $La_{0.5}Sr_{0.5}TiO_3$ polar layer is introduced to preserve the degeneracy of the Ti t_{2g} orbitals and minimize the disorder at the $La_{0.5}Sr_{0.5}TiO_3/SrTiO_3$ interface. Various thickness combinations of $La_{0.5}Sr_{0.5}TiO_3$and $LaAlO_3$ layers are used for tuning the total internal potential of the polar layer responsible for the charge transfer. Experimental data showed that the carrier density increases by raising the total internal potential, and this is in a good agreement with a simple electrostatic model. A complete metal-insulator phase diagram is obtained, which shows that at least 3.15 eV polar potential is needed to form the metallic interface at the $SrTiO_3$, providing an estimate for the critical thickness needed for the metallic phase. Nonlinear Hall effect was observed below 60 K which can be understood by multiple filling of the degenerated orbitals responsible for multiple band electronic conductions.

[1]Ariando Research Group is part of Department of Physics and of NUSNNI-NanoCore, the inter-faculty and multidisciplinary Nano-Institute at the National University of Singapore.

Haijiao Ma
NUSNNI-Nanocore and Physics Department, NUS

Date submitted: 14 Nov 2014 Electronic form version 1.4