Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Electron transport properties in self switching nano-diodes TATSUYA KISO, KAZUICHI NISHISAKA, TOSHIHIKO MAEMOTO, SHIGEHIKO SASA, Osaka Institute of Technology, SEIYA KASAI, Hokkaido University, MASATAKA INOUE, Osaka Institute of Technology — Ultra-fast novel nanodevices, namely the self-switching diode (SSD) were fabricated from the InAs/AlGaSb heterostructures grown by solid-source molecular beam epitaxy on a semi-insulating GaAs (100) substrate. The two lines were etched thorough the 2DEG layer and become insulating. The effective channel width was actually smaller because of the depletion layer at the etched boundaries. Depending on the sign of the applied voltage the effective channel width will increase or reduce, giving rise to the diode-like characteristics. The diode-like characteristics were clearly observed for the InAs SSDs at 300K, and turn on voltage is strongly dependent on the channel width of the SSDs. In the SSD with $W = 460$ nm, the InAs channel of was fully pinched of under the equilibrium condition, and positive voltage of 1.46 V was needed to drive a current thorough the InAs channel. On the other hand, the positive voltage of 2.32 V was needed to drive a current in the SSD with $W = 230$ nm. We found to need the higher the turn-on voltage in the SSD of the narrower channel width. Furthermore, multi-channel SSDs were fabricated. $I - V$ characteristics and the AFM images of the SSD array of the symmetric nanowires, which are 1.5 μm long and approximately $W = 170$ nm. The current densities were clearly increased with increasing the number of the nano-wires. The clear diode-like nonlinear behavior and rectification reflected ballistic nature of electrons in InAs-based SSD were observed.

Toshihiko Maemoto
Osaka Institute of Technology

Date submitted: 01 Dec 2011 Electronic form version 1.4