Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Optimizing electronic characteristics of SnO2 nanobelts for FET devices TIMOTHY KEIPER, JORGE BARREDA, Department of Physics, Florida State University, JIM P. ZHENG, Electrical and Computer Engineering, FAMU/FSU College of Engineering, PENG XIONG, Department of Physics, Florida State University — Oxide semiconductors are attractive channel materials for nanoscale field effect transistors (FETs), especially for applications in chemical and biological sensing. Here we focus on optimizing the current-voltage relationship and gating response of SnO_2 nanobelt (NB) FETs, a widely used sensor material. The NBs are grown by a physical vapor-liquid-solid process, with dimensions are desirable for FET application, however the electrical characteristics of the as-grown materials are often not optimum for high-performance FETs. We have developed a multistep thermal annealing procedure in low vacuum ranging from 150 to 250 °C and oxygen environment at atmospheric pressure and 600 °C to increase the conductivity by more than 10^3. The multistep annealing process is necessary to consistently obtain FETs with low resistance, Ohmic contacts which differ by $<5\%$. Utilizing a typical backgate geometry the device is transitioned from the on state to the off state over a gate voltage range of less than 30 V through a thick 250 nm SiO_2 dielectric layer. The On/Off ratio is as large as 10^4. We surmise the oxygen annealing effectively activates the NBs while the vacuum annealing both helps clean the material and tune the carrier density at the surface, affecting metallization.

Timothy Keiper
Florida State Univ

Date submitted: 14 Nov 2014

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